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ENGINEERING NEWS-RECORD

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FRANK C. WIGHT
Editor

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Muddling Through

NO INDUSTRIAL struggle can profitably be ended with complete victory for one of the two sides, for such a consummation will inevitably store up resentment and future outbreak. The unprecedented length of the anthracite strike and the strength with which both operators and miners have held out for their contentions have for a long time shown that it could not end in a one sided victory, so the compromise solution of last week was to be expected, and to a degree is a happy one. Whether or not the public is to be benefited remains to be seen. For a time at least the status quo is restored, arbitration of future disputes is indicated as a possibility, though by no means a certainty, and the concession of the check-off seems to be the price the operators pay for the concession of arbitration from the miners. The anthracite industry is thus restored to self control—until the next controversy arises. Meanwhile the administration and Congress will probably be only too glad to assume that coal is not a public concern and will continue to ignore the measures to control the industry proposed by the Harding Coal Commission. Muddling through has traditionally saved Great Britain from political disaster; possibly it may have equal success in our policy regarding coal.

Business in Construction

ONE of the interesting features of the development of business organizations in the fields of construction materials and contracting is their influence in the direction of clearing up some unbusinesslike elements of bidding, specifying and contracting. Some protests lately made by one of the youngest of these organizations, a fabricators' association, against incomplete bidding plans and unfair contract clauses are the most recent contribution to this influence; but in one form or another every association of trade or construction interest tends in the same direction. The reason for it may be recognized in the fact that every engineering contract involves the interaction of two parties, the engineer on the one side, the material man or builder on the other, and that the latter is therefore very keenly aware of every point in which the former's requirements are impracticable or unfair. For a like reason we may expect that associations of construction engineers will operate to the improvement of specifications, contracts and other business elements of construction. They will not make the parallel work of the trade associations unnecessary, however. There is ample scope for both agencies.

Charging for Street and Road Use

MAYOR Nichols of Boston has stirred up a hornet's nest among the automobile interests of his town by proposing that a fee be charged for the privilege of parking on the city streets. Probably he will not be able to put such a reform over, but it has its points. It is just as well to stop now and then and consider how far we are going to go in this communal payment for communal privileges. Some things—the general use of the streets, the protection of the police and the sanitary services, for instance—have been freely used by all and have been therefore paid for by all in such proportion as can be arrived at by the accepted method of general taxation. Other things, such as the water supply, are paid for in proportion to use. Into this class are rapidly moving the use of streets and roads for certain purposes. Every car that is parked on Tremont St. in Boston or State St. in Chicago diminishes the use of those streets to the rest of the citizens—who are paying for that use. Every owner of a parked car is getting a special privilege, which obviously is available to and wanted by only a few. By the same token every user of the proposed new highway west of the Holland tunnel is the recipient of special privilege, not desired or used by the majority of the citizens of New Jersey who are expected to pay its enormous cost out of their current highway expenditure. Whether we like it or not the trend of events is moving us toward toll roads and bridges for special cases and toward no parking in certain districts. If charging for parking wakes the people up to what an abuse of privilege parking really is it will be a good thing to put in force.

Donating Millions

NOW that an explanation is at hand to tell why the government is asked to cancel $37,000,000 of its investment in reclamation projects, it may be inferred—for the explanation is not complete enough to allow anything more definite than an inference—that a large part of the proposed write-off is a pure donation. Part of the remission recommended by the Board of Adjustment is due to expenditures from which the landholders derive no benefit, and may therefore be regarded as an equitable adjustment; but this is not true of the entire sum. Since the members of the Board of Adjustment were able, well informed and of high purpose, it is safe to accept their judgment that the write-off should be made, in order to remove all possible ground for complaint and grumbling from the reclamation states over the burdensome charges put upon the projects. After the reclamation investment has been scaled down as recommended, there ought to be no further delinquencies of payment on the part of the landholders and no further remissions or postponements on the part of the government; and, it is to be hoped, the congressmen of the western states will no longer bring in relief bills and other legislation tending to disorganize the workings of the Reclamation Act. Thus, the prospect is for peace and satisfaction to follow the long period of discontent in reclamation. But the fact of the write-off will remain—proof that the plan of carrying out federal reclamation as a self-sustaining enterprise has turned out a failure. Shall we build more reclamation projects on the same fallacious basis?

Field Research

THERE is much unutilized opportunity in construction work for making incidental investigations of unsettled engineering questions. In recent years, fortunately, the opportunity has been recognized in increasing degree. It is coming to be understood that field research makes it possible to gain knowledge of the working conditions governing design and other engineering operations, in a way that laboratory study often cannot duplicate. Certain branches of engineering are particularly interesting in this respect. Branches whose development is slow and gradual rest largely on intangible experience, and to a much less extent on data of measurement. Dam construction is an instance. Such branches form attractive fields for investigative work done to working scale on actual structures. The studies made on the Brule River dam (p. 274) afford an example of the kind of knowledge to be obtained, and its value to the engineer who has to deal with the stability of dams. This work, as well as special investigations like the Stevenson Creek test dam in California, means progress. But it is plain that specially arranged researches, such as those last cited, are likely to cost very much more than comparable studies made as an incident to construction work. It is from researches which are tied in to the daily contact of engineering construction that we have most to hope for in the progress of the art.

Purveyed Concrete

COMMERCIAL production of concrete is developing improved technique. It is for its demonstration of this advance that the description in this issue of the commercial concrete plant at Birmingham, Ala., is chiefly important. Purveying concrete is not novel; there have been several undertakings of the kind in years before the present group of commercial plants mentioned in the article began to attract attention. These first enterprises were mostly failures. Whatever business causes there may have been for this poor success there was ample technical reason for disaster. The concrete was uncertain in quality at the plant and it suffered in character in transportation. Both of these possibilities are potential hazards in any later-day attempt to purvey concrete. They can be met only by precise quality control of the mixer product and by so handling the product in delivery that it has not suffered deterioration when it arrives at the place of use. Improvement in quality control at the mixer is well illustrated by the Birmingham plant. There are also far better means now, in motor trucks and special containers, for carrying wet concrete long distances without damage. With all these advantages exercised one has every reason to expect as high quality from purveyed concrete as from the product on the job of the average builder or contractor. Let the conditions, however, be kept carefully in mind. Commercial concrete in its present development is far from being a standard material.

Municipal Market Design

NEW information on a novel form of municipal enterprise is found in Mr. Bowen's article on the St. Louis municipal market and garage. City owned markets are common enough, but few municipalities have gone into the garage business. The future possibilities of this type of undertaking make the details of design and operation at St. Louis most valuable as a record.

The St. Louis market is of a kind quite distinct from the Chicago produce market described in *Engineering News-Record* of July 23, 1925, since the former provides an open public hall with numerous stalls for retail dealers serving the public directly, while the latter represents the cellular division of a number of large buildings in order to provide independent storage and shipping facilities for each one of a number of wholesale dealers who sell to the retail men. In preparing for the St. Louis enterprise, careful study was made as to the various facilities required and as to the arrangement and equipment of modern retail markets in other cities, with the result of introducing several improvements and of developing a plan which represents the latest ideas in convenience for the merchants and the public.

Structural design was but one of many elements considered. Other elements included the utilization of the floor area to combine numerous stalls with wide aisles; the design and lighting of counters and show cases; the refrigeration and cold storage facilities; the special equipment of stalls for meat, poultry, fish and dairy products; the general lighting and ventilation; the handling of goods, and the daily disposal of a large volume of garbage and rubbish. In the upper floors, there was the problem of combining maximum parking capacity and maximum convenience in the handling of cars. And finally there was the layout of the basement for possible utilization as a motor-truck garage to serve the big downtown mercantile establishments, or as a union terminal for bus lines.

The St. Louis and Chicago markets together indicate the value of the engineer's work in a special phase of municipal activities. But in addition they show how far afield from some of the ordinarily accepted phases of routine design and layout the engineer sometimes has to go.

High Early Strength Concrete

IN THE past few years there has developed a strong demand on the part of engineers and contractors for a concrete that would attain in a short time a strength sufficiently comparable to the ordinary final strength of concrete to permit either the early removal of forms or early opening of the structure to service. This demand seems to have developed quite suddenly. For years constructors had accepted with little or no question the slow hardening qualities of concrete and had fitted their design and the technique of construction to this quality. Only lately has it come to be regarded as a disability, the removal of which would lead to economies in design and improvements in construction.

To meet this new demand there was developed for commercial use the long-known alumina cement, which resembles portland in all of the structural qualities with which it endows concrete but which without having a flash set attains in 24 hours about seventy per cent of its final strength as against ten to twenty per cent for ordinary portland. In Germany, too, the manufacturers of portland cement set about certain improvements in material and methods whereby they developed an improved portland which has a 1- to 2-day strength equal to the 7- and sometimes the 28-day strength of ordinary portland. The alumina cements, however, cost from two to three times an ordinary portland, and the

improved portlands require such revisions of method and equipment that so far no American mill has attempted to market them, but if they were available they, too, would bring an increased price.

At this juncture, then, comes the interesting announcement of the Universal Portland Cement Co. that high early strength concrete can be obtained by the proper use of ordinary portland cement. To obtain a 3-day concrete strength exceeding the ordinary 28-day strength of portland-cement concrete it is only necessary, according to this company's bulletins, to do the following things: (1) decrease the mixing water; (2) increase mixing time to 5 min.; (3) increase the amount of cement; (4) place the concrete and keep for three days at 70 deg. F.; (5) keep the concrete damp, for 3 days and (6) on occasion use calcium chloride as an accelerator. By such means a 3-day strength of over 2,500 lb. has been attained, and that strength obviously is high enough to permit liberties of form removal and of use far beyond anything possible with concrete as ordinarily produced.

This may come as a surprise to many users of concrete, but in fact it is merely the amplification of some of the long known properties of concrete and of some others not so long known but fairly well revealed in recent tests. That more cement, less water, longer mixing and proper curing make stronger concrete, for instance, has been pretty thoroughly hammered home, but that this higher strength begins early enough in the setting process to offer constructional advantages has been little appreciated. The series of tests on which the Universal company is basing its campaign are well authenticated, though as yet not published. They show, for instance, that an ordinary concrete, 1:5 mix, with a water-cement ratio of 1.03, that is with 7.7 gal. of water per sack of cement, and with 1 minute mix, has a compressive strength of 240 lb. per sq.in. at 1 day, 750 at 3 days, 1,320 at 7 days and 2,880 at 28 days. If the mixing time is increased to 5 min. the 1-day strength rises to 340 and the 3-day to 910. If the water content is decreased from 7.7 to 6.1 gal., 1-day strength becomes 520 and 3-day 1,350. If cement is increased so that there is a 1:3 instead of a 1:5 mix, which reduces the water content to 5.5 gal., the 1- and 3-day strengths become 560 and 1,580, respectively, and if the water is still further reduced to 4.4 gal. the strengths are 880 and 2,410, which are increased to 1,150 and 2,860, respectively, if this last mix is kept in the mixer 5 min. Thus we have in three days a concrete, workable and usable, which is as strong as the normal 28-day concrete, temperature and curing conditions being kept up to laboratory standards.

Further study of these tests shows that all of the procedure and precautions that lead to high final strength of concrete not only increase the high early strength but also increase the proportion that early strength bears to final. Thus concrete which attains 2,500 lb. at 28 days reaches only 8 per cent of that value at 1 day and 28 per cent at 3 days, whereas 6,000 lb. concrete reaches 20 per cent at 1 day and 50 per cent at 3 days. Thus the benefits of strong concrete are emphasized in its early strength. Portland cement in itself not having the early rise strength-time curve of alumina cement, concrete made from portland can never reach to as high a proportion of its final strength in one day as does that made from alumina, but it can, such tests show, reach in three days a respectable strength, sufficient for most structural purposes.

This having been said, however, a warning must be given. High early strength portland cement concrete is gained by the exercise of the utmost care in manufacture. The properties of alumina cement are such that ordinary concreting procedure produces high early strength concrete. Not so with the portland cement concrete. In the laboratory it is a simple matter to reduce mixing water to the optimum amount, to juggle aggregate proportions so that this optimum amount produces a workable mixture, to mix five minutes, and to maintain temperatures of 70 deg. F. during the mixing and placing and for three days thereafter. On the job this is far from easy. Only slowly are the actual workers in concrete being educated up to the necessities of correct proportioning and definite water control. So far they have been approached on the ground that such precautions add to the strength and durability of concrete, but their failure to observe any of the new methods has been largely an economic loss. In other words, concrete that will stand up, for a time at least, can be made by the long accepted methods generally in use. It has been the claim of the concrete reformers that the new methods merely make better concrete, stronger at the time it is made and of better expectation of life and, incidentally, that this better concrete might be made cheaper. In this new idea of high early strength concrete, however, lies the danger that the new convert may become too thoroughly converted, and that having taken what he construes to be the proper precautions he proceeds to early form removal or early use with disastrous immediate consequences in case his conception of proper method happens to be wrong.

And this is so far from a remote possibility that warning should be given that the rules for 3-day concrete must be used only by the expert. Doubtless with the utmost care in planning and with the most careful supervision 2,500 lb. concrete can be reached at the end of three days, but the opportunity for failure in the process is so great that where structural stability is concerned the builder would best go warily in its use. For roads, streets, footings, any location where failure is not cumulative, the careful builder can undoubtedly take advantage of the new methods to accelerate his construction operations. But to suggest to the ordinary concrete worker, who as is only too well known has difficulty normally in producing a 1,200-lb. concrete in 28 days, that he can pull forms or load his concrete in three days with the assurance that it has a strength of 2,500 lb. would be dangerous business.

The value of this new suggestion lies in the possibilities it opens to the thinking concrete man, in the visualization it gives him of what can really be done with concrete if brains are mixed with it. It adds a somewhat spectacular note to the routine story of better concrete. If by taking thought and care, and spending money for more cement, the user can make his concrete ready for use in three days he may begin to realize that by taking thought and care, and by using only as much or possibly less cement than he has been using he can produce a better concrete for the 28-day, and all time, use which, after all, in most structures is of vastly more importance than is any ability to use in three days.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Municipal Retail Market and Garage at St. Louis

Four-Story Building With Market on First Floor, Garage Above—Ramps Serve Basement and Garage Floors—Garbage Disposal—Cooler Rooms—Market Equipment and Rental—Garage Service

By L. R. Bowen
Chief Engineer of Bridges and Buildings, St. Louis, Mo.

ONE of the first projects completed under the $87,000,000 bond issue authorized at St. Louis, Mo., in 1924, is the new union retail market and garage, which was opened in November, 1925, and is owned and operated by the city. It replaces the old Union Market which occupied half of a site purchased for this purpose by the city in 1865 for $245,000 in 6 per cent 40-year bonds. This site is now valued at about $800,000. The cost of the new building was about $1,275,000, of which $1,000,000 was from 4½ per cent 20-year bonds sold at a premium of $18.99, the remainder being taken from municipal revenue. A view of the building is given in Fig. 1.

Site and Building—This new market, which is only about a block from the main retail district, is a four-story structure covering the entire block between Broadway, Morgan St., Sixth St., and Lucas Ave., 195½ x 270 ft. On the first floor is the market, with its accessories occupying half the basement space. The other three floors constitute the garage. Broadway and Morgan St. are important retail streets; the former 60 ft. wide, and the latter now being widened from 50 to 80 ft., for which purpose the building was set back 30 ft. from the old line. Sixth St., 60 ft. wide, is of less importance, and like Broadway, has a street-car line. Lucas Ave., 50 ft. wide, is largely a service street for business establishments fronting on Washington Ave., so that it is little more than an alley. Both Broadway and Sixth St. are level, but the former is about 4 ft. higher. In order to have every entrance lead directly to the market without steps, the floor was given a fall of 4 ft. to the west side, with a grade of about 1½ per cent.

Nine entrances were placed on the three main streets, with the receiving room and basement ramp approach on Lucas Ave., as shown in Fig. 2. Much of the sidewalk space on this side was utilized for areas lighting the basement. Each main entrance has three doors 3 ft. wide. Smaller entrances lead in from the stair and elevator halls at the north corners. Iron-spotted gray brick for the exterior walls rests on a base of tooled red Missouri granite and has a terra-cotta trim matching the color of the brick. In architectural style it leans to the Italian Gothic, with pointed arches sprung from buttressed walls and extended through the second story. These arched openings, with sills 9 ft. above the sidewalk, are fitted with iron grilles.

Structural Design—Fireproof construction is used throughout, including steel doors and window frames, the only woodwork being the refrigerator doors. Spread footings were designed for dead-load plus one-third the live-load; a pressure of 5,000 lb. per sq.ft. was used, giving approximately 3,600 lb. for dead-load. As pockets of sand exist in the stiff yellow clay below the ground-water level, there was some doubt as to its bearing power, but levels indicate practically no settlement. Reinforced concrete with flat-slab floors and spirally hooped columns was used throughout, except that steel trusses and columns were employed for the fourth story and roof. With this steel construction, three rows of interior columns are omitted in the fourth story. The trusses are light, since they have to carry only a roofing of cement tile.

To provide market stalls 20½ x 18½ ft. and aisles

FIG. 1—MUNICIPAL MARKET AND GARAGE, ST. LOUIS, MO.

10 ft. wide, the interior column spacing was fixed at 30¾ x 28¾ ft., with end spacing of 27 ft. 7½ in. for the longer and 25 ft. 7½ in. for the shorter dimension. As this arrangement makes the end spacing approximately nine-tenths the interior spacing, it equalized the moments in the end and interior spans and simplified the flat-slab construction. The columns have 6½-ft. capitals and drop panels 10 ft. square. Drain, vent and soil pipes are embedded in the columns.

A 100-lb. live-load was adopted and the floors were designed with the two-way type of reinforcement, following in general the recommendations of the Joint Committee on Concrete and Reinforced Concrete. The slabs are 11½ in. thick for the garage floors and 12 in. for the market floor, exclusive of the wearing surfaces. All of the interior columns are of the spiral hooped type and vary in diameter from 27 in. on the third floor to 36 in. in the basement. These columns were designed in accordance with the formula of the city of Chicago, checked by the formula of the Joint Committee. Exterior columns, uniformly 48 in. wide, vary in thickness from 21 to 27 in. The columns of the upper floors are reinforced with vertical rods and bands only; those of

the first floor and basement have each a double set of spirals with the necessary vertical bars. The exterior basement columns are in reality part of the basement walls.

All interior concrete columns are of circular section, but in the first story they are brought to octagonal shape with metal lath and plaster. Spandrel beams are used at each floor and were designed to support one-third of the adjacent panel loads and the curtain walls. The roof consists of precast cement tile supported on light steel trusses of 30½-ft. span which are framed between trusses of 56½-ft. span, the whole being carried by 8-in. H-columns and the curtain walls of the fourth

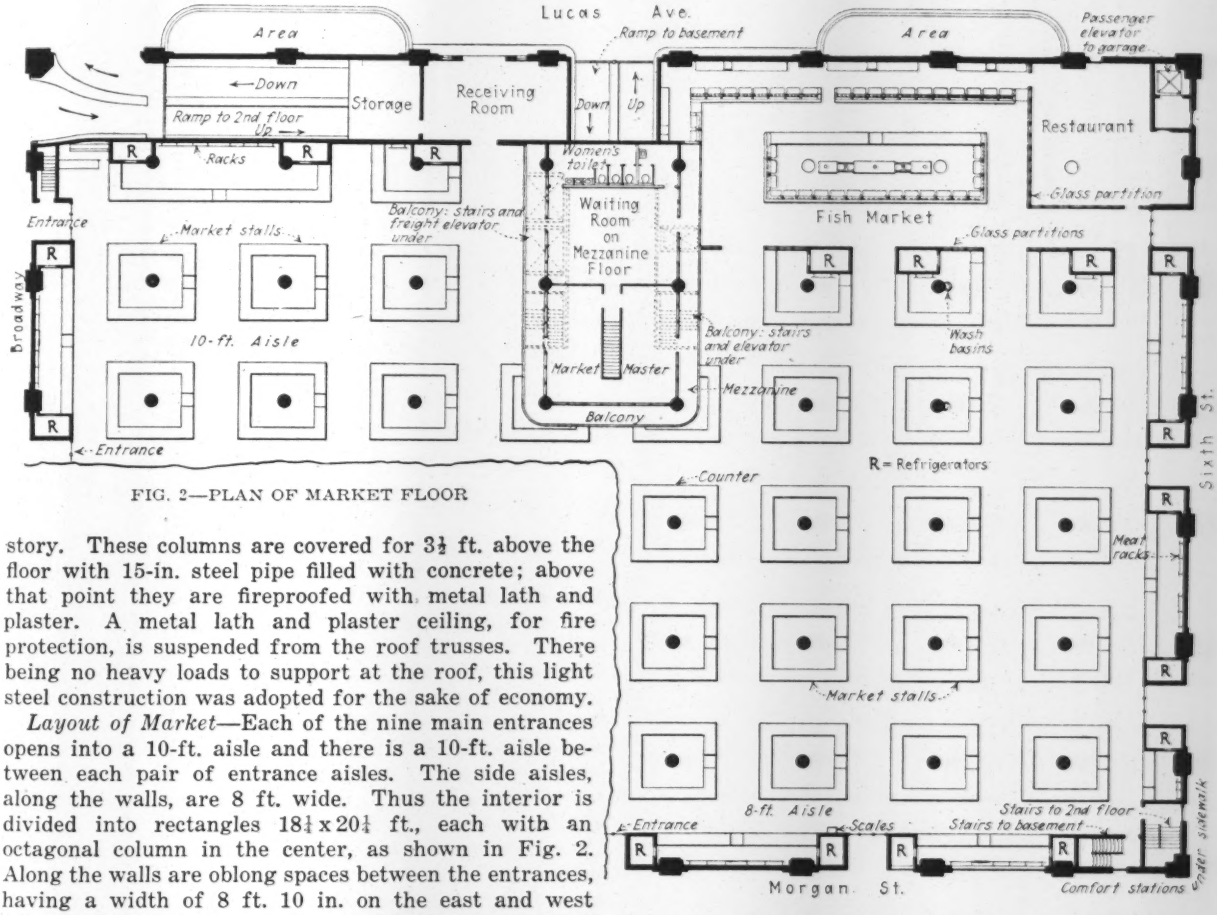


FIG. 2—PLAN OF MARKET FLOOR

story. These columns are covered for 3½ ft. above the floor with 15-in. steel pipe filled with concrete; above that point they are fireproofed with metal lath and plaster. A metal lath and plaster ceiling, for fire protection, is suspended from the roof trusses. There being no heavy loads to support at the roof, this light steel construction was adopted for the sake of economy.

Layout of Market—Each of the nine main entrances opens into a 10-ft. aisle and there is a 10-ft. aisle between each pair of entrance aisles. The side aisles, along the walls, are 8 ft. wide. Thus the interior is divided into rectangles 18¼ x 20¼ ft., each with an octagonal column in the center, as shown in Fig. 2. Along the walls are oblong spaces between the entrances, having a width of 8 ft. 10 in. on the east and west sides and 7 ft. 10 in. on the north side. In general, each space contains two booths or stalls. No goods are sold in the streets outside the building. White enameled brick lines the interior walls to a height of 9 ft., above which are the windows, with ventilating panels operated in groups. These openings have screens of bronze wire in frames of copper-bearing steel.

Wood blocks set in asphalt are used in the stalls to form a sanitary floor that will not tire the feet of the salesmen and will make it unnecessary to introduce the usual unsightly wooden floor racks. This floor construction is shown in Fig. 4. For the aisles, the floor is finished with 1½-in. terrazzo, made up with black and white marble. A base of dark terrazzo is formed at the edges of the counters and is brought up to a level surface to form a base for the white enameled brick, which are laid in white cement mortar. The floors of the stalls are level, although the aisles have a slope to the west.

Each stall has a lavatory with hot and cold water. On each column are mounted four 16-in. oscillating fans having a swing of 90 deg., except that only two are used at each of the fish and poultry stalls. These fans are finished in cream colored enamel baked on, to match the paint of columns, walls and ceilings. Power circuits for meat grinders and other appliances are provided at each stall. On the columns and wall pilasters are 8-in. bands of white vitrolite about 9 ft. from the floor, above which are vitrolite squares having the numbers of the stalls inserted in black. The lessees of stalls are required to have their names in plain black letters on the bands, but no other signs or advertisements are permitted. These details may be noted in the interior view of the market floor, Fig. 5.

This market arrangement was adopted after a study of markets of a similar class in other cities. It was found that usually there is erected over each stall a rectangular steel framework supporting a channel on which are marked the merchant's name and stall number, and from which are suspended spot lights for the showcases. A principal object of this framework is to form racks for hanging merchandise. But in a study of markets in large cities it was found that only the meat and poultry dealers seem to have a real use for these racks, other dealers using them to store old boxes and baskets or similar material. In general, the steel framework was unsightly and obstructed the view of

the market. To paraphrase an old saying: One could not see the market for the stalls.

For the St. Louis market it was decided to omit all overhead racks, except for the meat and poultry stalls. Furthermore, these stalls were placed along the side walls, where racks and hanging meats would not obstruct the view, and where small refrigerator rooms could be built for a reserve of stock. At each of the nine entrances the brick walls are brought out to form these refrigerator rooms, one serving each meat and poultry stall (Fig. 2). They are about 5 x 6 ft. inside, and 7½ ft. high, lined on all surfaces with 4 in. of sheet cork which is plastered and finished with white enamel paint. Meat racks and refrigerating coils are supported by a steel framework. Along the enameled brick walls at the back of the meat and poultry stalls are display meat racks built up in three tiers and composed of steel heavily tinned and polished. Each of these stalls has also a refrigerated showcase and a refrigerated space under the counters. Each poultry stall is equipped with a cutting board, as described later for the fish stalls, but the lessees of the meat stalls are required to furnish their own meat blocks, which must be of a small oblong shape to fit the restricted space.

The clear height to ceiling varies from 18 ft. at the east to 22 ft. at the west, owing to the slope of the floor. In the middle of the south half of the room is a mezzanine floor 11 ft. above the main floor, built over the ramp leading from Lucas Ave. to the basement. This mezzanine floor is divided into offices by steel and glass partitions and has also a waiting room or rest room 25 x 30 ft., attractively furnished. This is for the use of customers and is connected with small toilet rooms for men and women.

Counter and Showcase Design—All counters, with white enamel brick walls, have a surface of white

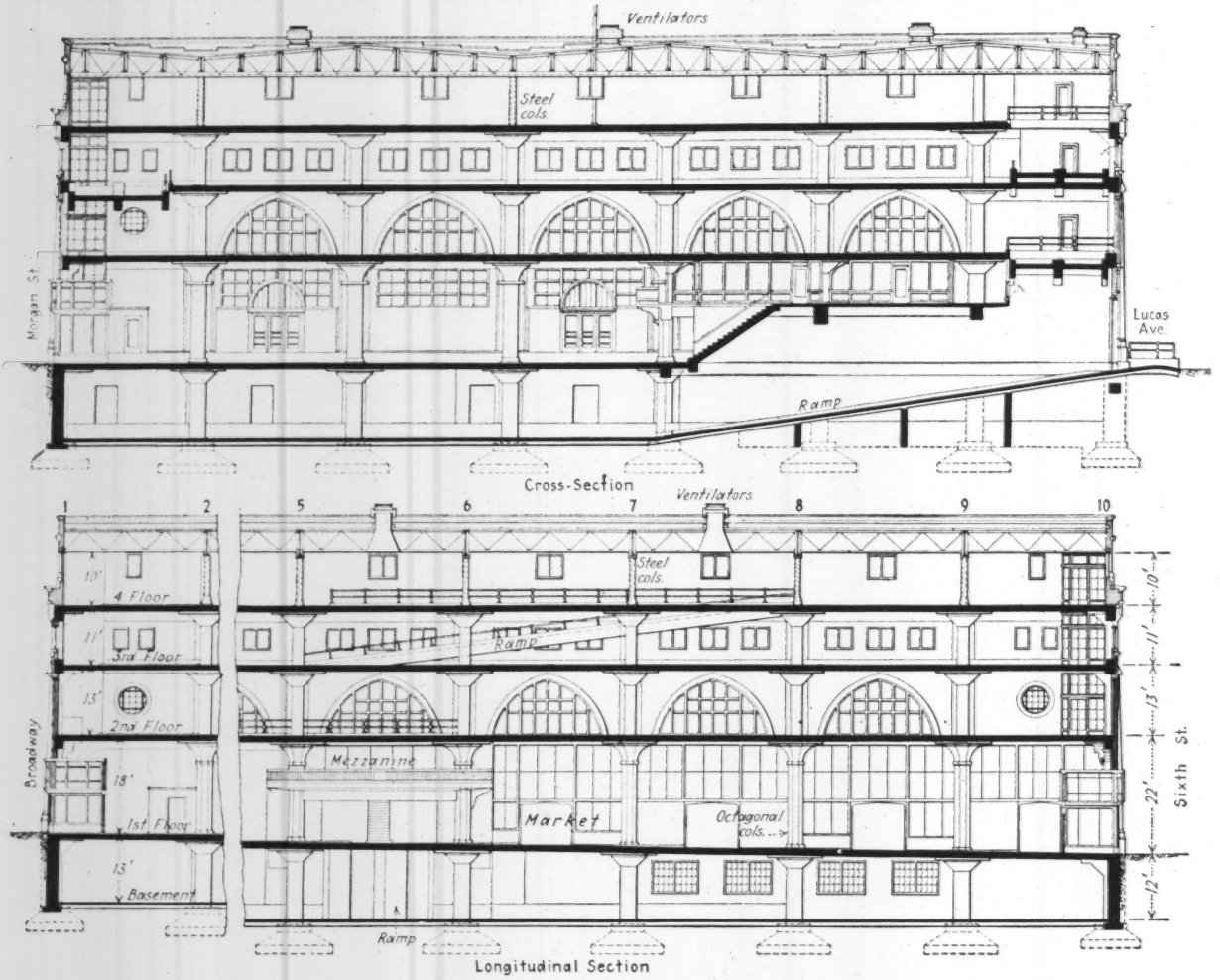


FIG. 3—CROSS-SECTIONS OF MARKET AND GARAGE BUILDING

vitrolite or structural glass, 34 in. wide and 30 in. from the floor. This material is non-absorbent and easily cleaned, and its high polish sets off the goods more effectively than a dull surface. It is somewhat more fragile than marble. Along each side of the stall, Fig. 6, is a basket rail consisting of three ¾-in. brass pipes on cast bronze brackets built into the brick wall. This forms a shelf for customers' baskets and protects the counter from damage by trucks. All the counters have glass fronts to protect the goods.

Three types of refrigerated counter protection cases are shown in Fig. 6. Type *A*, with a vertical front surmounted by a horizontal shelf, is the most common, but as the junction of the glass pieces is about on the line of vision, the customer has to stoop or stretch to see the goods. Type *B* is therefore coming into general

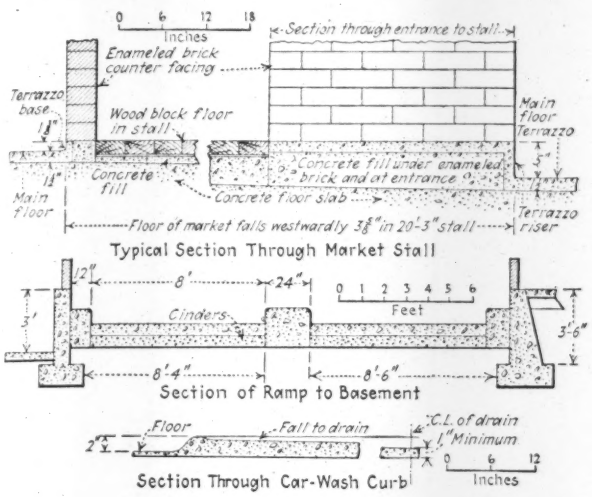


FIG. 4—FLOOR DETAILS

use, as the joint is outside the line of vision; but package goods cannot be piled in this case without much loss of space. In both types the exposed edge of polished glass is subject to chipping and breakage. To obviate these defects, type *C* was designed, consisting of one sheet of glass bent to 6-in. radius. This design was found to afford perfect vision, but manufacturers asked a large additional cost and type *B* was adopted as the best available. However, the writer believes that type *C* is far preferable and can be made economically.

In the showcases as installed, the front glass is mainly ¼ in. thick, but the horizontal pieces are ⅜ to ½ in. thick, depending upon their width and span. All the glass is supported on the counter top by aluminum brackets with felt bearing strips, and all glass edges (except the polished front edge) are covered with channels of nickel silver. Refrigerated cases on the counters are 18 in. high for the meat and poultry section, but 24 in. in the dairy product section in order to admit tubs of butter. These cases have 2-in. brine coils at the back; a gutter in the bottom of the case carries off the drip when the coil is being de-frosted. Glass doors in oak frames slide in nickeled channels, but can be removed for readier access to the cases on busy days. In these counter cases, where there is so much uninsulated surface and the doors are opened frequently (or even taken off), the idea of refrigeration is largely psychological, but the frost-covered coils look cold and the cases are clean and sanitary. Refrigerated spaces below the counters have brine coils, insulated oak doors and cement floors sloped to drains. All surfaces are lined with 2 in. of cork coated with plaster. Where no refrigeration is provided, the space under the counters is fitted with adjustable steel shelves.

A novel system of showcase lighting was designed in order to avoid the use of overhead construction. Lamp receptacles about 4 ft. apart are fitted to the aluminum brackets and the lamps (at the top of the case) are hidden by covers of cast nickel-silver with vent holes and white enameled reflectors to throw the light downward. Wires are led along the nickel channels on the back edge of the glass. Two 25-watt lamps were to be used in each case, but as these heated the shields to 140 deg. it was necessary to have 15-watt lamps made for the purpose.

Fish Department—A fish section 44x84 ft., Fig. 2, is separated from the main market by a steel and glass partition on an enameled brick base and having three openings, without doors, for the market aisles. Exhaust fans in the south wall ventilate the market through this section, so that no fish odors may permeate the market. For display of fish on cracked ice, there are rows of solid porcelain trays about 20 x 38 in. and 7 in. deep. Each tray has a drain and 2-in. cork insulation on the bottom and ends, this insulation having been found necessary to preserve 50 per cent of the ice for 24 hours.

Stands for cleaning fish at the back of the stalls have 24-in. cutting boards 5 to 10 ft. long mounted on pipe framework. These boards are of maple strips 1¾ x 3 in., glued and bolted together, each board having a ¾-in. rim and a 10-in. hole through which the cuttings fall into a removable 15-gal. aluminum tank. Slop sinks into which the cutting boards drain are supplied with hot and cold water and are connected to the sewer through large water-jacketed grease traps. The stalls have the wood-block paving already described. At the southeast corner is space for a restaurant about 37 ft. square; except for a pot sink the equipment for this will be furnished by the lessee.

Interior Lighting and Heating—A 300-watt lamp in

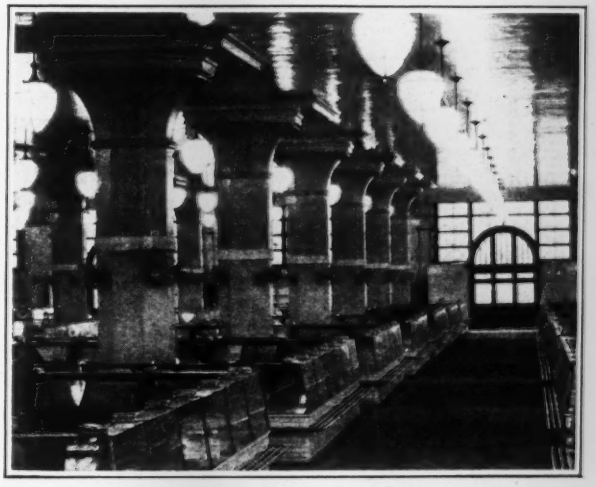


FIG. 5—INTERIOR OF MARKET

a specially designed globe carried by a steel sling is suspended from the ceiling at and midway between each intersection of the aisles. These lamps provide a minimum illumination of 6 foot-candles. For heating, there are twelve 21½-in. motor-driven fans blowing over copper radiator pipes and each delivering 3,000 cu.ft. of air per minute. These units are mounted on and insulated from the small refrigerator rooms along the outside walls. Direct radiation is used in the fish section, with pipe coils on the south wall. The ventilation system has been noted above.

Steam and electric current for light and power are purchased from the Union Electric Light and Power Co., the steam being purchased on a condensation basis plus a fixed charge for radiation during the heating season. Refrigeration is purchased on a yearly basis from the St. Louis Refrigerating & Cold Storage Co., which has liquid ammonia supply lines and ammonia gas return lines in the business district. The liquid ammonia expands around the pipe coils in two brine

coolers 40 in. in diameter and 16 ft. long, from which the brine is pumped through the coils of the market and cooling rooms.

Removal of Garbage and Rubbish—Each stall has a 15-gal. aluminum receptacle for garbage and these are brought to the garbage room after market hours to be emptied into one of the trucks of the city's garbage collection service. They are then washed, sterilized with live steam and returned to their respective stalls. The garbage room, 16 x 29 ft., has walls of white enameled brick and is ventilated by two exhaust fans discharging 9 ft. above the sidewalk. It has a large galvanized sink supplied with hot and cold water and live steam. A bin 28 x 30 ft. is provided for depositing boxes and other containers to be removed by trucks. In view of this system of removing garbage and rubbish no incinerator was installed, which is a departure from usual practice in the handling of such market waste.

Public Comfort Station—Under the sidewalks at the northwest corner of the basement are two toilet rooms 12 x 62 ft., for men and women. These have sidewalk lights and exhaust ventilation. About half of the toilets are of the pay type, with locks operated by a 5c. coin; there are also toilet booths 4½ ft. square, provided with lavatories, soap and towels, and having locks operated by a 10c. coin. In the main rooms, towels and soap are supplied by an attendant. All toilet rooms have hot-blast electric air-dry machines.

Elevators and Trucks—For the market service there are two 5,000-lb. freight elevators 8 x 10 ft., running from the main floor to the basement, while a smaller elevator serves the fish section and basement. Plunger-type hydraulic elevators were adopted because of the restricted head room. About thirty hand trucks are provided for handling merchandise and three for the garbage receptacles. There are also ice, mop and other service trucks. All trucks have rubber-tired, ball-bearing wheels.

Basement and Ramp—In the middle of the Lucas St. side of the building is a ramp for trucks to the basement, where the principal deliveries to the market will be made. This ramp, on a grade of 14¾ per cent, is 20 ft. wide, with 12-in. side curbs and a 24-in. middle curb to divide the traffic. It is closed at the street level by electrically operated swinging doors, with push-button control from both levels.

In excavating the basement for a minimum clear height of 11 ft., advantage was taken of the slope in the first floor, the eastern part of the basement being made 3 ft. higher, thus providing an unloading platform, which is served by the two large elevators. This raised portion contains also the meat and vegetable cooling rooms, vegetable cleaning room, garbage room, toilet and locker rooms, refrigerating machinery room and an isolated room 25 x 28 ft., with outside doorway, for the hot-water heaters, elevator pumps, meters and switchboards. A smaller raised portion, served by the fish-room elevator, contains the cooling rooms and ice breaker for the fish market, so that fish is not handled through the main market room. About half the basement area is not utilized as yet. It was planned to lease this space for the storage of motor trucks of large mercantile establishments, but it has been suggested that the city should establish in it a union terminal for interurban bus lines. Decision will be deferred until it is found how much traffic will be brought into the basement by the market deliveries.

MARKET RENTALS

Stalls		Rent	Stalls		Rent
17	Meat	$65 to $175	2	Groceries	$125
7	Poultry	65 to 110	2	Candy	65
9	Dairy products	80	3	Bakery	65
7	Fish	90 to 100	5	Miscellaneous	65
13	Fruit and vegetable	62.50	1	Cigar stand	40
			1	Restaurant	250
15	Delicatessen	80	65	Cooler rooms	15 to 20

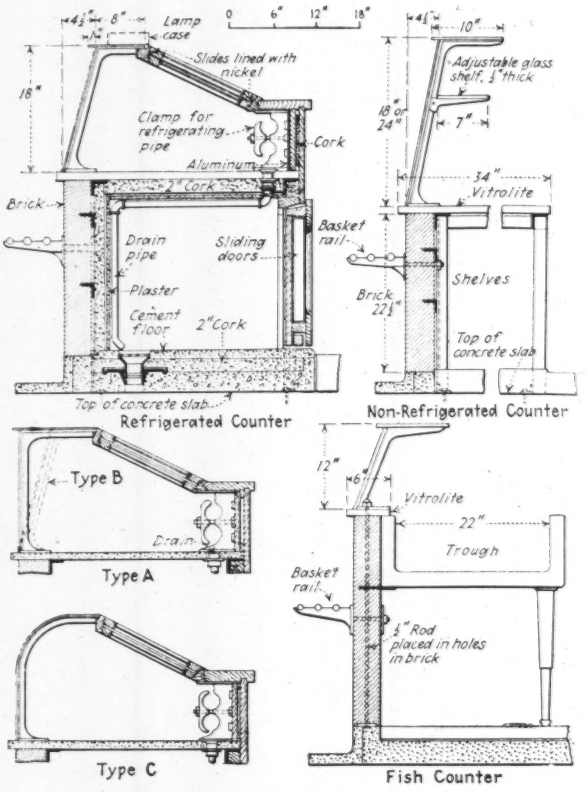


FIG. 6—COUNTER EQUIPMENT

Cooling Rooms for Storage—Dealers will keep their reserve stocks of meat, vegetables and fish in the basement cooler rooms, about 56 x 86 ft., 56 x 72 ft., and 34x65 ft., respectively, all lined with 4 in. of sheet cork and having white enamel plaster on the walls and cement floors. Insulated anterooms are provided at the entrances. Each room is subdivided by steel wire partitions, painted with butcher's white enamel, the wire being more sanitary than the usual wood slats. There are thirty meat rooms 10 x 11 ft., and 27 vegetable rooms 9 x 11 ft., with 6-ft. aisles. Pipe coils are placed along the back walls, and gutters in the floor under the coils drain to the sewer. Vertical coils were used here, for while they are somewhat less efficient in refrigeration they are much easier to maintain. Recording thermometers are installed, and it is intended to maintain temperatures of about 32 deg. F. in the meat cooler, 36 deg. in the vegetable cooler and 26 deg. in the fish cooler.

A vegetable cleaning room 29 x 53 ft. is divided by steel wire partitions into thirteen rooms 8 x 10 ft. which are leased with the vegetable stalls. Each room, serving two dealers, is equipped with hot and cold water and has a galvanized iron sink connected to the sewer through a water-jacketed grease trap. This subdivi-

sion, which is an unusual feature, was introduced as an aid to cleanliness by reducing the responsibility for the condition of each room to not more than two persons.

Market Rental—All the stalls and cooler rooms have been leased on a monthly basis at prices given in the table. Rents for main stalls vary on account of size and location, and those for the refrigerated stands include refrigeration. There were applications for

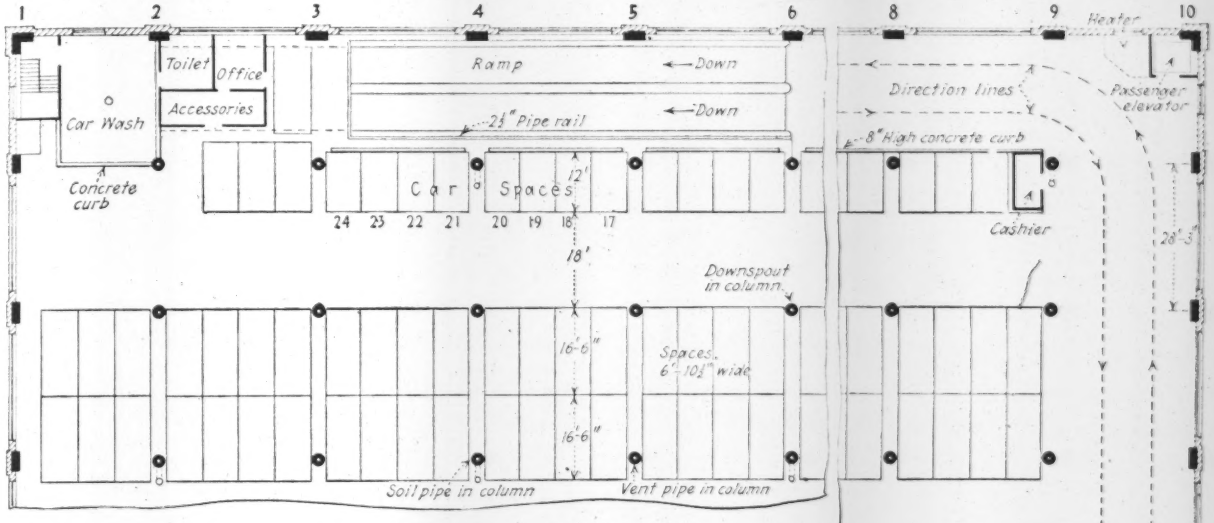


FIG. 7—PLAN OF SECOND FLOOR: GARAGE

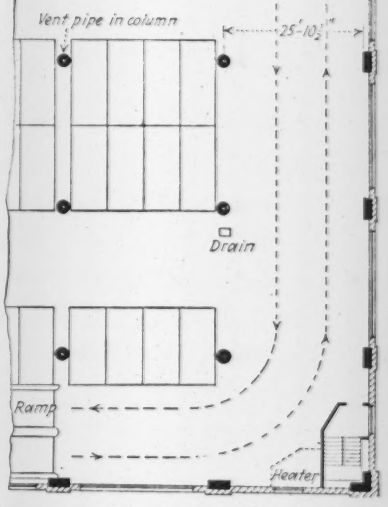
about three times the number of stalls available, but the rents were held at low figures in the hope that they would be reflected in the prices charged to the public. The aggregate annual rental is $104,070 for the market stalls and $11,820 for the basement cooler rooms.

Municipal Garage—With the column spacing determined by market requirements on the first floor, there are seven bays 28¼ ft. c. to c. and nine 30¼ ft. c. to c. On the garage floors, 20-ft. aisles run in the direction of the longer bays, as it was estimated that four cars could be parked conveniently in the minimum clear space of 27 ft. 9 in. Both the aisles and car spaces are outlined in 2-in. stripes of yellow paint, while a red stripe with direction marks indicates the center line of the main passageways. There is a capacity of about 200 cars on each floor, or 600 in all. A typical car space is 16 ft. 6 in. x 6 ft. 10½ in. These spaces are marked by 10-in. figures and the aisles by 15-in. letters. A clear height of 10 ft. is used in these floors, except that in the second floor it is 12 ft. to accommodate

FIG. 8—INTERIOR OF GARAGE

automobile shows and similar exhibits (see Fig. 7). In all floors the walls are lined with white enameled brick. An interior view and part plan of the second floor are shown in Figs. 7 and 8.

Concrete ramps 20 ft. wide, are located alternately along the north and south walls, which are the longer sides of the building. These ramps have side curbs 12 in. wide and a 24-in. middle curb, all 10 in. high. The ramp from the first to the second floor has a rise of 18 ft. and a grade of 15½ per cent. Its entrance leads from Broadway, on the east side, but the exit is turned at the first floor to reach Lucas Ave., on the south side (Fig. 2), as there is no sidewalk on the rear side of Lucas Ave. Both doorways have swinging doors controlled electrically from the first and second floors.



The ramp to the third floor has a rise of 13 ft. with a grade of 14½ per cent, while that to the fourth floor has 11 ft. rise and a 12½ per cent grade. During the construction of the building these ramps were used for trucking materials to the upper floors. At diagonally opposite corners are two full-automatic electric passenger elevators with push-button control, but each having a switch for changing to direct control by an attendant. Enclosed stairways with steel panic or emergency doors are provided at the other two corners of the building.

Floor Surfacing—In the garage the floors are finished with a ½-in. layer of 1:2 grout composed of portland cement and trap rock; this was placed integrally with the floor concrete and was troweled to a smooth finish. A 1½-in. layer of grout on the ramps had a rough float

finish and was marked with transverse grooves. To give a hard and dense surface, the second and third floors and all the ramps were treated with a magnesium fluosilicate solution applied in two coats of 7½ and 14½ per cent strength respectively; the fourth floor was given two coats of a solution of 16 per cent zinc sulphate and 4½ per cent sulphuric acid.

Garage Equipment—Each floor has an office, toilet room, a room for the sale of automobile accessories and a car-washing space with an air-unit washing system drained through separately ventilated garage traps. This washing system includes duplicate nozzles for the car and engine, each fitted with 20 ft. of hose for hot and cold water and compressed air. A motor-driven compressor maintains 100-lb. pressure in an air tank 20 x 60 in., the pressure being reduced to about 75 lb. before entering the nozzles. This tank also serves a low type of tire inflating stand near the exit ramp on each floor.

An illumination of 1½ to 2 foot-candles is furnished by 300-watt semi-indirect ceiling lamps in the centers of the bays. Eight heating units on the second and third floors are similar to those of the market, except that they are housed in sheet-steel hoods connected with openings in the walls, so that air can be supplied to them from the outside or inside of the rooms. The fourth floor units are similar, but have 37½-in. fans delivering 9,600 cu.ft. of air per minute. In the roof there are eleven 36-in. glass-top ventilators. No fire-protection sprinkler system was installed, as it was thought to be ineffective where gasoline is stored, but the market and garage floors are equipped with hose racks and fire hose connected to 4-in. standpipes. On each floor also there are twelve 2½-gal. foam-type extinguishers and six 1½-quart vapor-type extinguishers.

Operation of the Garage—This garage is operated directly by the city. A superintendent and cashier have offices on the second floor, and there is a floor man on each floor. Two janitors are employed and one elevator is handled by an attendant, while the other is operated by the push-button control. The car-washing equipment and the sales rooms or stores for accessories will be leased as concessions.

The parking charge is 15c. for the first two hours and then 10c. per hour or fraction of an hour, or a lump sum of 35c. per 12-hour day. This garage is open from 7 a.m. to 7 p.m. on week days only. Up to Nov. 11 it had been in operation about three months and its use was steadily increasing. It then handled about 601 cars daily, with average daily receipts of $161.46. It has handled 1,098 cars in one day, 535 of these being taken care of on the second floor. It is expected that as the market business develops the garage will operate at full capacity, which should be about 1,500 cars daily.

Engineers and Contractors—The principal contractors for the building and the approximate cost of the work are as follows:

Construction of building—Fruin-Colnon Contracting Co.	$778,000
Plumbing and drainage—Wm. Hunt & Son	72,000
Electric work—Gamp Electric Co.	56,000
Heating and ventilating—F. E. Newbery Electric Co.	40,000
Hydro-electric elevators—Wm. A. Miller Co.	13,000
Electric passenger elevators—Chas. A. Reid	12,000
Refrigerating and insulation—Gus V. Brecht Co.	65,000
Comfort stations (except plumbing) J. J. Clark Construction Co.	17,000
Counter equipment—B. B. Hanak Co.	98,000
Miscellaneous: construction and equipment	64,000
Plans and supervision	60,000
Total	$1,275,000

The St. Louis union market and garage was designed entirely in the Bridge and Building section of the Board of Public Service. E. R. Kinsey, president of the board, is responsible for the project and for the decision to add the garage to the market building and thus get a larger return from the investment. The design of the building and equipment was done under direction of the author, assisted by the following members of the staff of the bridge and building section: E. E. Christopher, architect; W. R. Crecelius, civil engineer; Hector Updike, mechanical engineer; and Col. F. N. Hatch, superintendent of construction. Charles Kamp, Cleveland, Ohio, assisted in the preparation of plans for the equipment. Foundation work was commenced in October, 1924. The garage was opened for service on Aug. 11 and the market on Nov. 5, 1925.

Tests of Water Pressures Under Brule River Dam

Dam Has Pipes from Foundation to Downstream Face—Fine Cracks in Bedrock Prove Practically Watertight

THE question of upward pressure on the foundations of dams is one of special importance, but actual records of measured pressures are very scarce. For this reason there is particular value and interest in the following information concerning the Brule River dam of the Peninsular Power Co., near Florence, Wis.

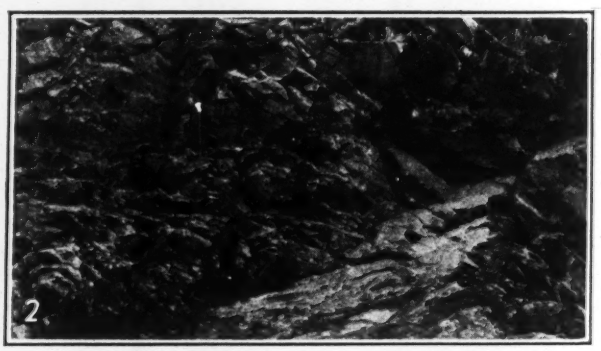


FIG. 1—ROCK AT FOUNDATION OF DAM
Cutoff trench in foreground; trench for drain at right.

FIG. 2—ROCK AT BASE AND SOUTH BANK
Note fine cracks and shattered condition of rock.

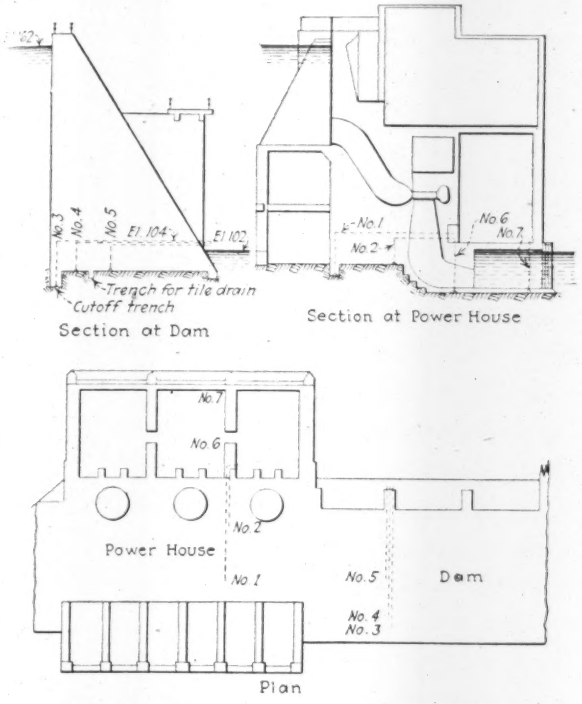


FIG. 3—LOCATION OF TEST PIPES IN DAM

This dam, built in 1919, is a concrete structure about 70 ft. high, 6 ft. wide at top and 48½ ft. at the base, sustaining an average working head of 60 ft. When the dam was under construction, as described in *Engineering News-Record* of May 15, 1919, p. 954, seven conical sheet-iron cups or foot pieces 12 in. in diameter and 9 in. high, were set on the clean bedrock, each cup being so located as to cover some of the fine fractures in the rock. The apex of each cup was connected to a 1-in. pipe extending vertically to an elevation above that of the tail water and then carried horizontally through the dam, projecting beyond the downstream face, so that pressure gages could be applied. These pipes were intended to indicate the pressure heads under the dam with the water at full head. Under-drainage is provided by a 12-in. vitrified pipe drain laid longitudinally under the dam, with 12-in. laterals 20 in. apart and extending beyond the downstream toe. These drains are laid in trenches filled with broken stone.

The character of the foundation of the dam is shown by the accompanying views. Fig. 1 shows the foundation rock, with cutoff trench and drainage trench; Fig. 2 shows the rock at the base of the dam and on the rise of the south bank. This rock, locally known as a "greenstone schist" is a crystalline rock very badly shattered or broken up, as the views show, but the breaks and cracks are so fine that in general they seem to be watertight. Fig. 3 shows the locations of the cups and pipes.

UPWARD PRESSURES ON BRULE RIVER DAM

Date 1923	Elev. of Head Water Ft.	Elev. of Tail Water Ft.	Pressure Head on Gages — No. 1 Ft.	No. 1 In.	No. 2 Ft.	No. 2 In.	No. 3 Ft.	No. 3 In.
Sept. 30	155.9	99.4	22	2½	13	4	28	5
Oct. 3	157.9	100.2	23	7	14	6	30	5
10	154.8	100.0	21	6½	13	4	27	9
15	153.4	100.1	21	2	13	2	..	.
20	156.9	99.4	22	6	13	6	..	..
25	162.6	99.8	24	5	15	9	..	..
30	161.0	100.5	24	0	14	7	..	..

Four of these, pipes 4, 5, 6 and 7, have shown no pressure. That is, the water has not risen to the top of the vertical pipe, so as to show flow of water; although it is considered probable that some water stands in the pipes. On the other hand, pipes 1, 2, and 3 have showed some pressure and a very slow flow. Some of the observations are noted in the table, while the diagram, Fig. 4, shows the relation of the head on the dam to the pressure on the gages. The evident irregularity in this relation is thought to be due to a lag in the variation of the pressure when the head changes.

It will be noted that the maximum pressure under the dam is only about 50 per cent of the pressure that would be due to the head of water. In this respect it is interesting to note that on both sides of the river the cutoff wall was carried into rock as solid as could be reached reasonably, all this rock exhibiting the same characteristic fractures as that at the base of the dam, Fig. 2.

After the dam was completed and full head raised, a small spring broke out through the rock below the south abutment and above the tail water. This

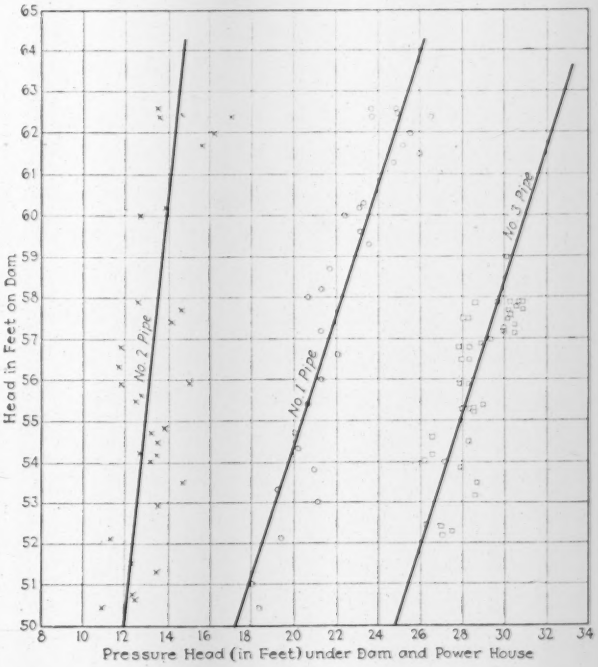


FIG. 4—DIAGRAM OF HEAD IN TEST PIPES

water, which undoubtedly came from the reservoir, must have flowed through the country rock around, under or to one side of the dam foundation or corewall, and finally reached this outlet, about 100 ft. from the face of the dam. In other words, there were evidently sufficient open crevices to transmit water; the quantity was very small, less than one second-foot.

The Brule River dam and hydro-electric plant were designed by and built under the supervision of Daniel W. Mead and Charles V. Seastone, consulting engineers, Madison, Wis. They are putting similar pipes in the dam now being built under their direction at Sandstone Rapids on the Peshtigo River, so that additional information as to the upward pressure on dams may be available in about a year.

Subways on Chicago Terminal of Illinois Central R. R.

Double-Track Subway for Junction Avoids Track Crossings—Foot Subway Under Crowded Street Leads to Station

TWO SUBWAYS presenting special features in design and construction are included in the various works for the improvement and electrification of the Chicago terminals of the Illinois Central R.R. One of these is a pedestrian subway forming the approach to the present Van Buren St. suburban station, which station is being altered and enlarged. The other is a double-track subway eliminating track grade crossings at the junction of the South Chicago branch line with the main line, near 67th St.

Pedestrian Subway—One of the busiest city stations for the suburban service of the Illinois Central R.R. is that at Van Buren St., but this station is separated from the business district by Michigan Ave., with its extremely heavy automobile traffic. To provide free passage to and from the station, a pedestrian subway has been built under Michigan Ave. and Grant Park. This subway has two stairway entrances on each side of Michigan Ave., and beyond the east side of the street it is divided into two branches; the upper-level branch leads directly into the station and to platforms used by outgoing passengers; the lower-level branch descends below and extends beyond the present station and under the westerly tracks to two island platforms used by incoming passengers. The grade of the upper-level branch is 5.67 per cent and that of the lower-level branch is 10 per cent. The total length of the subway is about 435 ft.

Under Michigan Ave., the subway is practically level, the descending grade toward the station being only 0.5 per cent. Since the roof of this section of the subway is almost at street level, a large number of pipes, conduits and other public utilities had to be cut and diverted. In its finished cross-section, the subway has a clear width of 18 ft. and a height of 7 ft. 6 in. under Michigan Ave., the dimensions inside the structural concrete work being 18 ft. 8 in. x 8 ft. The clear dimensions of the upper-level and lower-level branches are 16x8 ft., but in each case the width increases at the station connection, as shown by the plan, Fig. 1.

The floor of the main section of the subway is a 19-in. concrete slab carrying 15½-in. side walls, while the roof is of 15-in. I-beams spaced 19 in. c. to c. and embedded in a slab 18 in. thick. The floor, roof and walls of the two branches are all of reinforced concrete except that girders composed of pairs of I-beams embedded in concrete are used in the lower-level branch under the station, while precast 24-in. concrete slabs, with encased I-beams, are used under the two tracks. A concrete mix of 1:2:4 was used throughout.

To provide against seepage, the entire structure is surrounded by a waterproofing membrane which consists of five heavy moppings of coal-tar pitch, three layers of felt, and one layer of tartex, applied alternately in the usual manner. It is laid on a 5-in. bed of concrete under the floor and has a 6-in. protective concrete covering outside the walls. Over the roof the membrane is laid directly on the concrete slab and is protected by a concrete covering which, for the section of the subway that is under Michigan Ave., also forms the base for the asphalt pavement. Instead of a concrete covering over the membrane on the portion of the lower-level branch that is under the two tracks, a 1¾-in. layer of coal-tar-pitch mastic was used, with the track ballast resting directly upon the mastic.

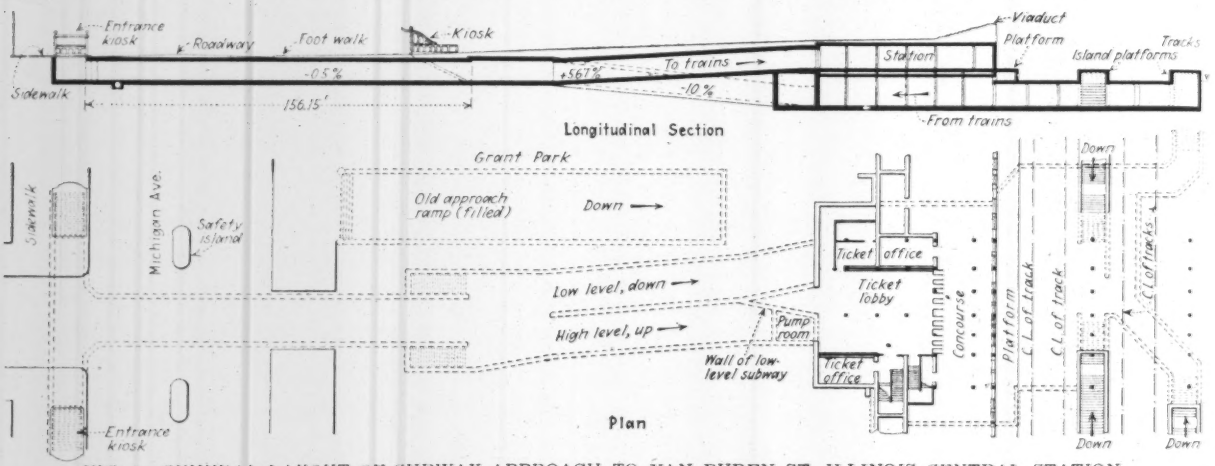


FIG. 1—GENERAL LAYOUT OF SUBWAY APPROACH TO VAN BUREN ST. ILLINOIS CENTRAL STATION

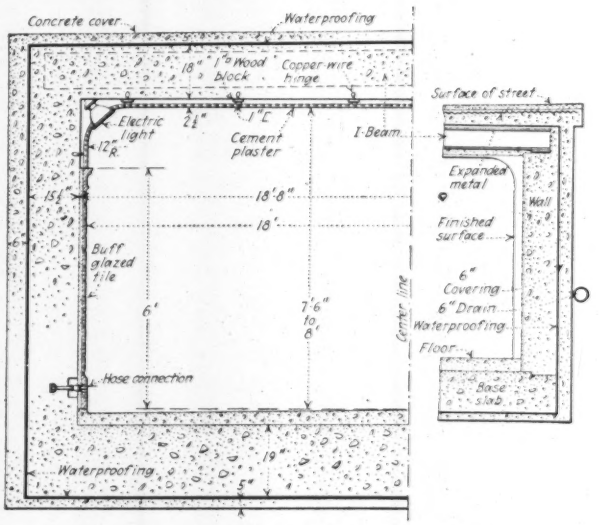


FIG. 2—SECTION OF PASSENGER SUBWAY

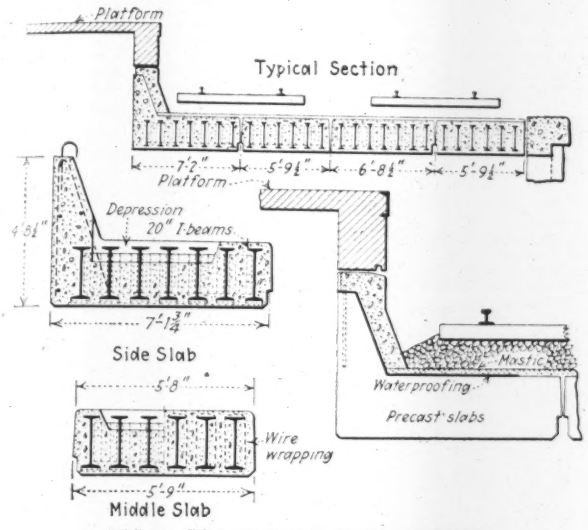


FIG. 3—TRACK DECK OVER SUBWAY

Upon the bottom slab of the subway is placed a 3-in. concrete floor, crowned slightly for drainage and finished by troweling to a hard and dense surface. Buff terra-cotta tile with glazed face and set in cement mortar is used to line the walls for a height of 6 ft. The ceiling consists of cement plaster on metal lath, stiffened by a framing of small channels and attached to copper hangers in the concrete roof. Wood blocks 1 in. thick were placed between the channels and the concrete, leaving an air space between the roof and the ceiling. At the sides the ceiling is curved down to meet the wall lining, forming a cove in which are recesses for electric lamps. The stairways have concrete steps with 12-in. tread and 6-in. riser, the tread projecting slightly beyond the riser, its outer half faced with a patented surface to prevent slipping. The kiosks covering the entrances to the stairways have reinforced-concrete roofs and the walls are of ornamental iron work on steel framing. Water flowing into the subway at the entrances, due to rain, melting snow or water used in flushing the floor, is drained to a sump in the pump room, which is located at the foot of the lower-level branch incline and has an electrically driven bilge pump.

Construction Methods—While the subway was being constructed under Michigan Ave., the entire width of the roadway was closed, but a shoo-fly or curved run-around roadway was built in Grant Park on the east side of the street, the parkway being covered with planking and planked inclines being built at the gutters. This roadway was about 300 ft. long on the chord and 60 ft. wide, with a 10-ft. walk on the east side, protected by heavy wooden railings. The roadway surface was of 2x4-in. yellow pine placed on edge and supported where necessary by 3x12-in. sleepers laid flat and spaced 3 ft. c. to c. The planked inclines constructed at the gutters to meet the sidewalk level were of maple. During the construction of the subway under the tracks, the tracks were carried on a pile trestle with approach spans of 13½ ft., having packed stringers, each composed of four 7x16-in. timbers. Over the subway excavation, which was retained by steel sheetpiling on both sides, a span of 35 ft. was required and here each track stringer consisted of three 24-in. I-beams.

Track Subway—Where the double-track South Chicago branch diverges from the main line, near 67th St., a subway or undercrossing is provided in order to avoid all crossing of, and interference with, other tracks. This is shown in Fig. 5. In diverging, the two branch tracks descend on a grade of 3 per cent and then pass diagonally under the right-of-way, beyond which they rise again on the east by a similar grade to the normal level of the branch line. Between the feet of the 3 per cent grades, the subway tracks are on a vertical curve about 1,000 ft. long. For about 360 ft. at the west end, the two incline tracks are in open cut between gravity retaining walls on pile foundations. At the east end, the open cut has earth slopes.

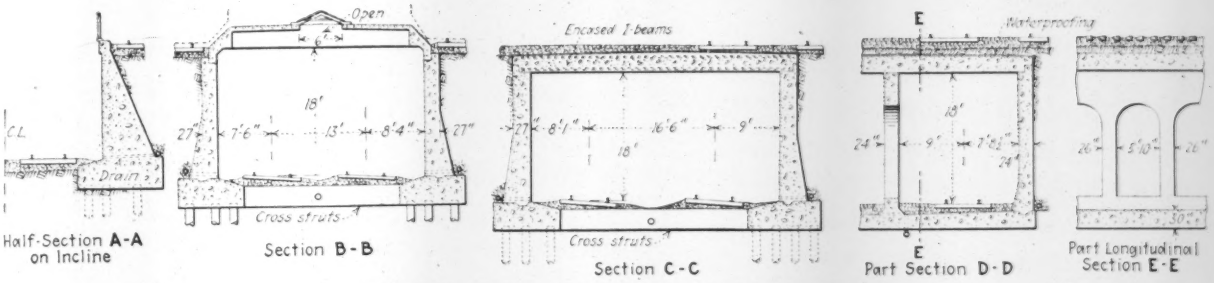


FIG. 4—TRACK SUBWAY UNDER MAIN LINE AT 67TH ST.

Three different types of section are employed for the subway, as shown by Fig. 4. As soon as the incline tracks on the main-line right-of-way reach a sufficient depth for clearance, they are covered as a protection against snow, although there are no tracks over the top of this first part of the subway. For about 100 ft., therefore, the side walls carry reinforced-concrete roof beams and a thin roof slab having ventilator openings with protective covers. Instead of a continuous floor slab, there are cross struts, spaced 15 ft. c. to c., between the wall footings, the spaces between the struts being filled with earth to form the subgrade for the ballast. In this section the roof is designed for a live load of 100 lb. per square foot.

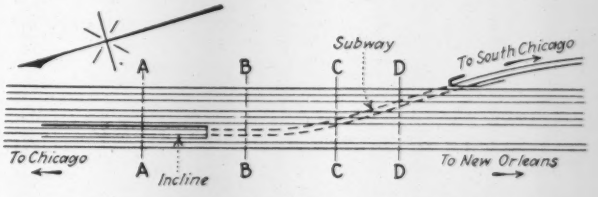



FIG. 5—SUBWAY FOR FLYING JUNCTION

For the next 180 ft., with a curve of 7½ deg., necessitating the spreading of the subway tracks to 16½ ft.

c. to c., and with tracks laid across the roof, the roof construction consists of I-beams 12 to 28 in. in depth, closely spaced and embedded in a concrete slab. To give the necessary side clearance for cars on the curve, the clear width is increased from 29 ft. to 33 ft. The wall and floor construction are the same as in the previous section, the cross struts being 18x36 in. and spaced 10 ft. c. to c. Then for about 250 ft., or to the east portal, the subway is divided into two passages by a central wall, as this part of the structure is subjected to heavier loading. Here the roof is of reinforced-concrete slabs and there is a continuous floor slab. The central wall consists of a series of arches to reduce its weight and cost. A bituminous waterproofing membrane covered with a layer of mastic about 1¾ in. thick is laid upon the roof wherever ballast is carried. All portions of the roof that support the main-line tracks are designed for Cooper's E-60 loading. Inserts in the roof provide for the attachment of supports for the catenary wires when electric traction is introduced.

Drainage—To prevent the blocking of the inclined approach with snow, steam pipes will be laid upon the ties in the open cut, as described in a later article. For the removal of rain water and melted snow flowing down the inclined approaches, side drains are laid along the walls and connected by lateral drains with catchbasins between the tracks. A longitudinal vitrified-tile drain connects the catchbasins and ends in a sewer connection at the low point. This pipe also serves to drain the roadbed between the cross struts in the floor. Where the subway has a solid floor slab, the tile drain has cemented joints and is laid under the slab. In the open cut with earth slopes, catchbasins are placed on each side and connected by lateral pipes with a central catchbasin served by a longitudinal drain.

Engineers and Contractors—All this work was planned and carried out under the direction of the Illinois Central R.R.'s organization for the Chicago Terminal Improvement, of which F. L. Thompson is vice-president, D. J. Brumley is chief engineer, and C. H. Mottier is engineer of design. The general contractors were the B.-W. Construction Co., for the Van Buren St. subway, and Chas. B. Johnson & Son, for the track subway near 67th St.

Sealing Operations on Cedar River Reservoir

The sluicing of a blanket of fine material on the porous areas in the Cedar River reservoir, on the Seattle water supply system, is still continuing. Just what success has attended the work thus far done is not definitely shown; some members of the city's official family declare that the basin can never be sealed and others assert that important improvement has already been effected. The leakage and the sealing operations were mentioned in *Engineering News-Record*, Feb. 5, 1920, p. 296. In the meantime the concrete dam, behind which the porous bank prevented developing the expected reservoir capacity, has not been a total loss because it has been able to store water up to the bottom of the notch left in the structure which is 35 ft. below the spillway level. In other words, the dam can be used to store 80,000 acre-ft. instead of the 160,000 acre-ft. that was originally planned when the development was undertaken.

Unloading Plant Practice on Road Work

Eight Types of Plants and Eight Plant Layouts Selected from Practice and Their Economy Analyzed

By Robert P. Petersen
Henry W. Horst Co., General Contractors, Rock Island, Ill.

Extract from a paper read before the American Road Builders' Association in convention at Chicago, Jan. 11-13, 1926.

THE various types of equipment used for unloading purposes are: (1) Hand unloading; (2) belt and bucket conveyors; (3) derricks, stiff-leg and full-circle; (4) locomotive cranes; (5) crawler cranes; and (6) bucket loaders. All of the types, except bucket loaders, are supplemented by some kind of unloading bin with proportioning hoppers. With this equipment, material can be handled satisfactorily

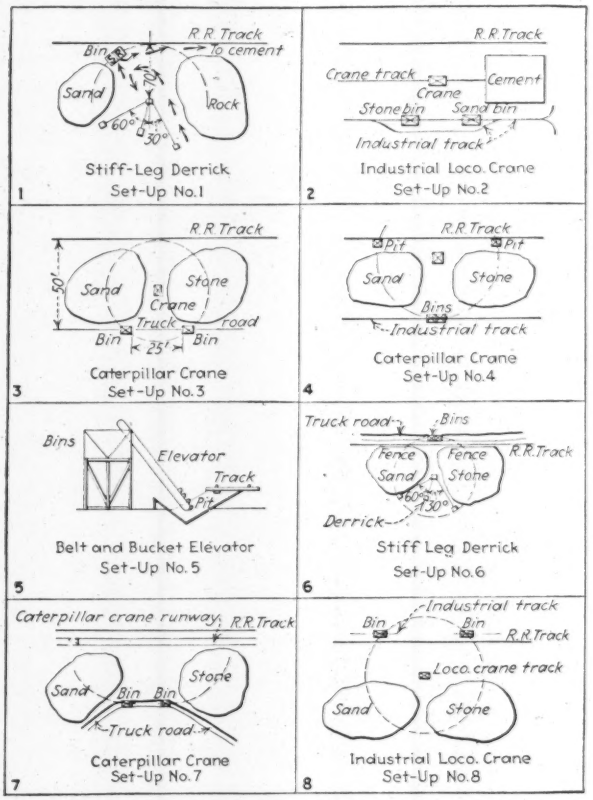


FIG. 1—EIGHT REPRESENTATIVE UNLOADING PLANT LAYOUTS

from the cars to the stockpiles or to the bins from whence it is proportioned and passes on to further job operations. The views of Fig. 2 show actual plants of the six types named.

From questionnaires to contractors it was found that 77 per cent have used cranes of various types, 60 per cent have used hand unloading methods, 32 per cent have had experience with derricks, 26 per cent have used locomotive cranes and 24 per cent have used conveyors and bucket loaders. The reported average initial cost and the estimated respective life of each kind of equipment are as follows: The locomotive crane, $14,000, and 7 years; the crawler crane $10,000, 6 years; the derrick $5,000, 9 years; conveyors and bucket unloaders $4,500, 6 years. The comparative average costs for handling materials from cars to bins, covering depreciation, labor, fuel, oil and supplies are: unloading by hand 26c. per ton; with bucket and conveyors,

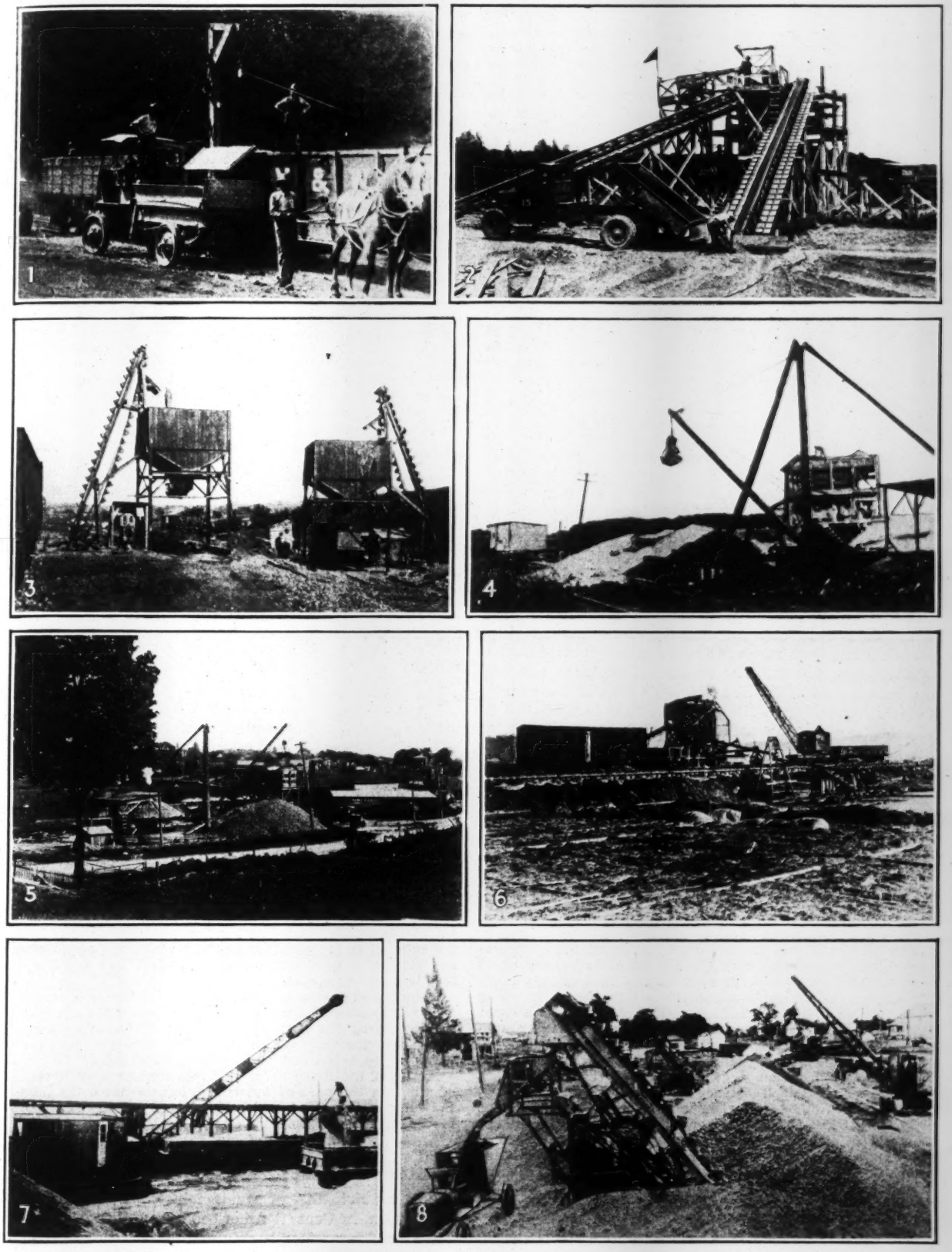


FIG. 2—EIGHT EXAMPLES OF UNLOADING PLANTS FOR ROADWORK

1—Unloading directly from car to truck. 2—Belt conveyors to overhead bins. 3—Bucket elevators to bins. 4—Stiff-leg derrick, cars to stockpile. 5—Guy derrick, cars to stockpile to bins. 6—Locomotive cranes from cars to bins. 7—Crawler cranes from cars to stockpile. 8—Bucket loaders from stockpile to trucks.

20c. per ton; with crawler cranes, 15c. per ton; with derricks, 14c. per ton, and with locomotive cranes, 14c. per ton.

In reviewing these various costs it will not be well to emphasize too strongly the results shown because of the fact that in an investigation of this kind there are not sufficient data available to establish an undisputed cost, but the information can be looked upon as fairly representative, keeping in mind that each individual unit will fluctuate widely because of many variable conditions prevailing at the plant site.

In choice of equipment the record is that 77 per cent of the contractors prefer cranes with the majority favoring gasoline power; 14 per cent have chosen locomotive cranes; 6 per cent are partial to derricks; and 3 per cent prefer conveyors and bucket loaders. The factors influencing the choice of the majority for cranes are: (a) Flexibility in operation and use on other work; (b) ease with which set-up can be made; (c) comparative economy in cost of operations; and (d) capacity and control of stockpiles.

Fig. 1 illustrates eight layouts selected from sketches submitted by contractors to show the best working relations between unloading equipment, tracks, bins and stockpiles. These layouts are summarized as follows: two set-ups involving derricks; two set-ups showing locomotive cranes together with industrial equipment; one set-up showing bucket unloader and three set-ups for crawler cranes—one of which is an industrial layout.

The features that are emphasized in these set-ups are large storage capacity, reduction of distance between stockpile and bin, reduction of distance between cars and bins, a combination of both of the previous things, and a flexible arrangement for both bins and cranes.

Reclamation Losses: Why a Write-Off Is Recommended

AN explanation of the $37,360,140 write-off of reclamation project costs recently recommended by a Board of Survey and Adjustment of the Interior Department has been received from a well-informed source in that department. The statement sketches some of the background of the board's work, and indicates that a certain part of the write-off is due to the improbability of collecting the full amount owed the government by the landholders.

Prior Conditions—This is the second board created to consider water users' requests for a reduction of project costs. The first such board was appointed in 1915 by Secretary Lane. Elwood Mead, present Commissioner, was chairman, Brigadier General William M. Marshall, Corps of Engineers, and I. D. O'Donnell, a prominent ranchman of Montana, made up the board. It dealt mainly with the settlers' complaints that errors in construction had increased costs and that they should not pay for these errors. With few minor exceptions, all of these complaints were disapproved. The board's report was pigeon-holed.

The board that has just reported was appointed by Secretary Work to consider requests for relief because settlers were unable to pay because some of the land was so infertile that a farmer could not make a living even if water were furnished free of cost. In other cases it was alleged that distance to markets and other conditions made profitable agriculture impossible.

Influence of Infertile Lands—The total of the losses that come under Subsection K of Section 4 of the enabling act of Congress (Second Deficiency Act, approved Dec. 5, 1924), that is, losses due to infertile land or other obstacles that prevent settlers paying, amounts in round numbers to $27,000,000, and this was swelled by the inclusion of items for expenditures which could not be recovered and items which the board thought ought to be paid from the reclamation fund, which total over $10,000,000, making a total of the amounts to be written off and of money which could not be recovered of $37,360,140.

The areas of infertile land were fixed by a soil classification of the projects. The soil experts divided the land into six classes, but as classes 1, 2, 3 and 4 are all regarded as able to pay, for all practical purposes there are only three divisions, (a) lands able to pay, (b) lands permanently unable to pay, and (c) lands not now able to pay but which may be made productive later on.

Bankrupt Projects—In some cases the write-off is based on a lack of irrigation development. It is not believed there can be such development as will enable the government to collect. Milk River is a project of this character. Here out of a total expenditure of over $4,500,000, a write-off of $3,800,000 is recommended simply because it is not believed that more than $770,000 can be collected. Up to this point the government has been unable to collect money enough to pay operating expenses.

Another case is the King Hill project, which was begun and has been operated as a private enterprise except for one brief period. The government was induced to advance and spend about $2,000,000 rebuilding the works, taking what was in effect the project's note for the money expended. None of this has been repaid, and during the period that the government operated only a part of the operating expenses were repaid. The project is now being operated by the water users, but in the opinion of the board the government will be fortunate if it can collect one-half of the money spent on the works and it is recommended that $818,000 be written off.

Nature and Effect of Report—In the original investigation in 1915 Secretary Lane took the position that is should be made by parties outside the Reclamation Bureau. When the Board of Survey and Adjustment was appointed, Secretary Work took the same position, and two out of three of the board members which dealt with each project had no connection with reclamation, except as they participated in this investigation. Ex-Governor Thomas E. Campbell of Arizona and Dr. John A. Widtsoe of Utah were two of the members of the board and the report is mainly of their preparation.

It seems certain that on some of these projects there is no likelihood of the government being able to collect the money which the board recommends be written off, and an early decision involves no loss to the reclamation fund. On the other hand, so long as this matter is undecided, it stands as a barrier to the willingness of the settlers to pay or the ability of the government to collect the sums that can and should be paid promptly. Delay will react against settlement of vacant areas and the improvement and better cultivation of farms now occupied.

Relation to Other Projects—Compared to the record of private irrigation development, this loss is not excessive, and there is no reason to regard it as an argument against new works, if proper precautions are taken in the preparation for development of new projects. When the existing works were started many of the problems of reclamation were not understood as they are now. Western states were impatient to have the money spent and development pushed through. The same impatience exists today, and because Secretary Work refused to rush into construction on projects which will cost $60,000,000 to complete he has been wrongly charged with being unfriendly to reclamation.

The last Congress, realizing the need for preliminary study, required the Secretary to have soil surveys made before the works were built, rather than afterwards, to fix the sale prices on privately owned land before construction, and finally, to determine that the project was feasible before letting any contracts.

Preparation for the economic and human needs of reclamation are more difficult and require as much time for their completion as the surveys and plans for constructing the works but they are of an intangible character and many western people do not realize their importance.

A few of the items seem to betoken an unusual liberality of mind on the part of the board, but do not detract from the value of its report, which it is hoped will have early and favorable consideration by Congress.

Guatemala to Improve Water and Sewer Systems

The municipality of Guatemala City, the capital of Guatemala, in Central America, is having studies made for a drinking water supply and distribution system, a sewerage system, and for new paving. The study will be made under the direction of the J. G. White Engineering Corporation of New York.

Wet Foundation Methods for River Front Building

Separate Cofferdams for Each of 218 Footings Laid Dry by Well Points and the Spoil Taken Out by Inclined Conveyor

EXCEEDINGLY wet foundations called for some interesting novelties in caisson and cofferdam methods in building a 13-story steel-frame warehouse recently in Chicago. The building stands close to the river, virtually on the dock wall. Sand overlying dense clay was excavated to river level. This clearing excavation left some 10 ft. of sand over the clay with rock 115 ft. below water level. The sand layer was soaked. On the river front, 193 ft. under the dock wall, and on the party lines (sides) 325 ft. and 415 ft., were cylinders going to rock, with some 218 interior column footings on pile clusters. The street front was 172 ft. Getting through the water-burdened sand with the foundations was the construction problem.

Each of the interior column foundations required a

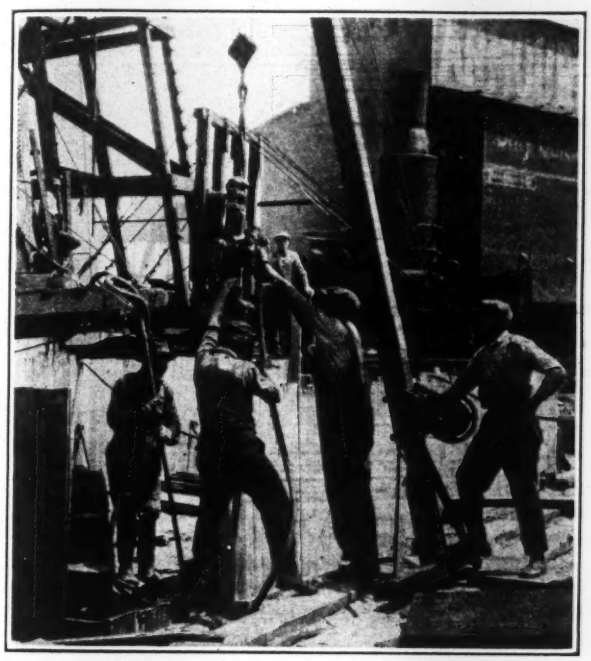


FIG. 1—DRIVING SHEETING FOR FOOTINGS
Man with water jet at left, inside enclosure. Two men handling pile-hammer. One man at pile-hammer derrick.

separate cofferdam around the cluster of foundation piles previously driven. One of the cofferdam operations is shown by Fig. 1. A pneumatic hammer slung from a gin-pole aided by water jet drove the sheeting about 12 ft. (through the sand and into the clay). A portable 4-cylinder gasoline compressor, shifted as desired, provided the air pressure. Excavation for the footings, inside the coffers, went down from 5 ft. to 11 ft. into the sand. This had to be done by hand as the bearing piles were only 30 in. apart on centers and virtually filled the area inside the sheeting. There was also water. This, however, was pulled down by well points and pumps so that the pit was dry. The disadvantages of hand digging between the pile heads were reduced materially by using portable inclined conveyors. These were run up to the cofferdam, with the lower end going down into the pit and the upper end discharging to trucks. The men shoveled onto the lower end of the conveyor. One-yard trucks took the spoil to a chute over the line of the Chicago Tunnel Co. which goes under the site and there chuted it into cars.

Where cylinder foundations to rock were used a steel shell was employed to penetrate the sand layer and into the clay. With the seal with the clay completed, the

FIG. 2—EXCAVATING PLANT FOR FOUNDATION WELLS
Well hoists on elevated platforms for dumping spoil into motor trucks, at right. Bins, mixer and tower at left. A spouting system served nearly the entire area.

well to rock was put down in the usual manner by curbing it with wood lagging held by inside ring bracing. The caissons averaged 5 ft. in diameter and the steel shells were sunk by loading them with sand bags and excavating inside. The unusual feature, shown by Fig. 2, was the elevated platform over the shaft by which the spoil could be shoveled into truck-tractors underneath. Individual electric hoists also were employed, one for each caisson. A portion of the plank road for truck haulage appears in Fig. 2. These roads all about the work were notable features.

The general building contractors were Henry Ericsson Co., Chicago, with Martin Larson as superintendent. Graham, Anderson, Probst & White were the architects.

Permeability of Natural Stone Measured

Permeability of representative natural stones to water has recently been determined at the U. S. Bureau of Standards. Slate and granite were found to be the least permeable, while limestone and sandstone were the most permeable. Marble appears to come after granite. Permeability of the stone must be considered with other properties before it is adopted as a building material. For instance, the present investigation was undertaken to determine the suitability of various stones for use in building a high dam. Apparatus was designed and constructed at the bureau by means of which the sample of stone can be subjected to any water pressure desired, up to 300 lb. per square inch. This pressure corresponds to a head of 700 ft. which was the height of the dam in question. The flow of water through the stone is then measured for a definite length of time.

Ready Mixed Concrete Easily Sold in Birmingham, Ala.

Mechanical Features, Testing and Inspection, and Business Methods of a Plant Selling Concrete that Utilizes Blast Furnace Slag for Aggregate

By W. E. Barker
Highways Bureau, Portland Cement Association

In the past two or three years, in different parts of the country, a new and unique article has been put upon the market. While the sale of concrete products, such as pavements, walks, houses, and many forms of blocks, has been common enough, it is only recently that the mixed, unhardened, concrete has been passed over the counter, just as a grocer sells sugar, or, more aptly, much as a fuel dealer sells coal. Apparently this new merchandising scheme has been uniformly successful. There seems to be a ready market for concrete in any large city, the purchasers ranging from the man who wants a few yards for an engine base or sidewalk to the road contractor who will take nearly the entire output of the plant for several months.

In Birmingham, Ala., the Sloss-Sheffield Steel and Iron Co. is selling ready mixed concrete to anyone who knows enough about concrete work to use its product intelligently. The steel company built the plant because slag, a byproduct of steel manufacture, could be used as aggregate. Sales have increased rapidly in the few months the ready mixed concrete has been on sale.

The Concrete Plant—The mixing plant is built along a paved street where it is readily accessible both to trucks and to the street railway company. It is near the slag pit which has for years been used as a dumping ground for the molten waste material coming from the company's blast furnaces and is connected with a crushing and screening plant which prepares slag for the local material market. New slag comes to the pit daily.

The concrete plant consists primarily of slag storage bins, measuring boxes, and two concrete mixers of 2-yd. and 1-yd. capacity respectively. The bins are of wood. Those above the larger mixer hold 15 yd. of slag and 10 yd. of sand while those above the smaller mixer have a capacity of 10 yd. of slag and 8 yd. of sand. Chutes carry the materials from the bins to the measuring boxes which are hung just above each mixer intake. Materials for the larger mixer are measured by volume but for the smaller mixer are measured by weight. Weighing is accomplished by hanging the measuring boxes on the levers of a beam scale. Proportioning by weight is especially convenient where many different proportions must be used, as in a commercial mixing plant, for it is much easier to reset a weight on a scale beam than to change the capacity of a volume measuring box. Materials are mixed in any proportions from 1:3:6 to 1:1:1½ as the purchaser wishes. The mixers are set high enough above the ground that they discharge directly into any vehicle. They are equipped with timing and water measuring devices and are turned by electric motors.

Materials Mixing and Marketing—The slag is the product of the acid process of steel manufacture. It is air cooled, weighs from 2,000 to 2,500 lb. per cu.yd. and has a French coefficient of from 5 to 5½, which is high for slag. It is mined by a steam shovel. Often it is necessary to blast the harder parts of the pit to break up the material so that the shovel can handle it. The slag is loaded into flat-cars and hauled to a dump hopper from which a belt carries it to a grizzly which catches particles larger than 2½ in. and sends them to a jaw crusher. Slag passing the grizzly, and that coming from the crusher, is carried to a rotary screen which separates it into the following 4 sizes: 2 to 1¼ in.; 1¼ to ¾ in.; ¾ to ¼ in.; ¼ to ⅛ in.

These sizes are kept separate in the bins of the crushing plant from which they are carried to the mixing plant by a belt conveyor. The slag is graded by regulating the amounts of these sizes onto the conveyor.

Every yard of concrete sent from the mixing plant is approved by an inspector, two of whom are on duty whenever the mixers are running. One inspector is supplied by the Southern Testing Laboratory of Birmingham. It is his duty to inspect concrete destined for clients of his laboratory. The Pittsburgh Testing Laboratory furnishes the other inspector who looks after the interests of all purchasers of concrete. For this inspection service there is a charge of 5c. a yd. which is paid directly to the laboratory by the purchaser. Cement is both bin and car tested. No cement is stored at the mixing plant for more than 15 days, the system of storage being such that the older cement is used first. Each customer can learn the car number of the cement which went into his concrete and can check the cement test records if he wishes.

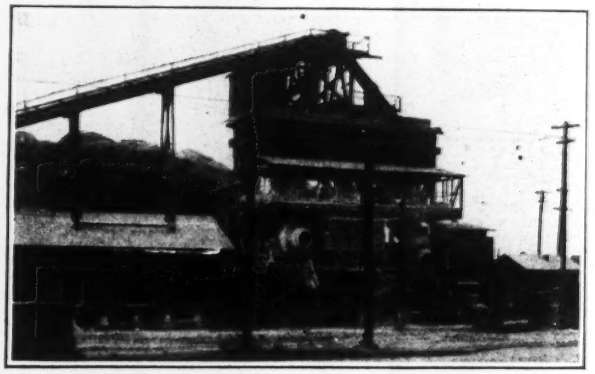


FIG. 1—COMMERCIAL CONCRETE PLANT, BIRMINGHAM

The plant was put in operation in October, 1924, but was not really ready for quantity production until January, 1925. For the first 12 months of operation, concrete sales were as shown in the accompanying table. For November, 1925, production climbed back to 8,500 cu.yd. and there was at that time enough business in sight to keep the plant busy all winter.

MONTHLY CONCRETE SALES

	Cu.Yd.		Cu.Yd.
October, 1924	2,627	April	6,251
November	2,706	May	6,606
December	1,416	June	8,510
January, 1925	2,402	July	10,100
February	2,855	August	5,635
March	3,362	September	6,614

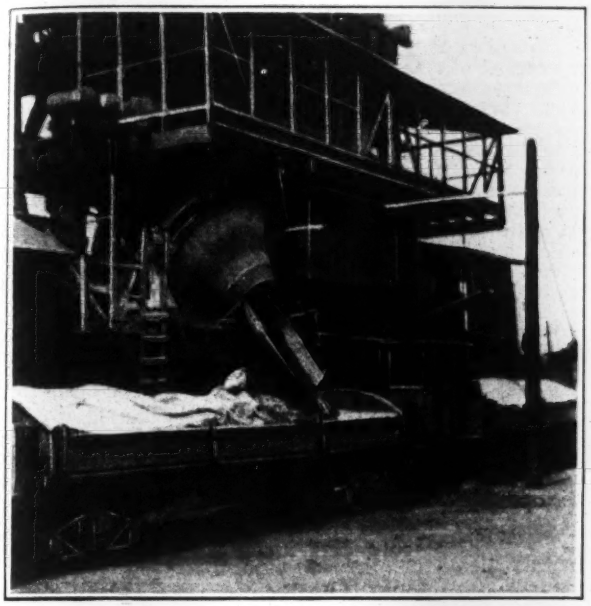


FIG. 2—STREET RAILWAY COMPANY PURCHASES CONCRETE, HAULING IT IN ITS OWN CARS

The largest day's run has been 768 cu.yd. The largest individual purchaser has been the street railway company which used 25,000 yd. in the first seven months of 1925. Small purchasers are the most numerous. On one day the output was 178 yd. and no one customer took over 10 yd.

Prices range from $5.20 per cu.yd. for 1:3:6 concrete to $6.75 for 1:2:3 concrete. Those figures are for small quantities. If a contractor wants concrete in such quantities that the plant can be kept constantly busy the price is reduced accordingly.

Most of the concrete is taken from the plant in trucks which range from Fords to those of 5-ton capacity. About 90 per cent of the output is hauled by contractors in their own trucks. The company, however, owns six Ford trucks and rents larger vehicles from a trucking company when they are needed. The hauling charge is 55c. per yard-mile for the first three miles. For longer distances the charge varies with the condition of the roads over which the load must pass. When a load leaves the plant in company trucks the driver is given two tickets, one for the purchaser and the other to be signed by the purchaser and returned to the plant. The ticket shows the name and address of the purchaser, quantity of concrete and the charge therefore as well as the hauling charge. This part of the ticket is made out by the plant foreman. In addition, the inspector notes the kind of concrete, the time the load left the plant, and the proportions used in the mixture. Each ticket is signed by the inspector. When the purchaser does his own hauling the truck driver signs the receipt and is given the purchaser's duplicate and passes it to his employer.

The street railway company hauls in flat-cars, carrying from 8 to 20 yd. at a trip. The concrete is covered with a tarpaulin to keep it from drying out in transit. Most of it is used in building track foundations.

Concrete has been successfully hauled to Bessemer, a distance of 18 miles, without any noticeable segregation. The slag aggregate used weighs 80 lb. per cubic foot and does not settle to the bottom of the load as heavier aggregates might do on such a long haul. The inside of each truck body is mopped with paraffin to insure easy dumping. Concrete is mixed 2 min. Consistency depends upon the wishes of the purchaser, ranging from that which will give a ¾-in. slump to a 2-in. slump. The slag is kept wet before going to the mixer so that it will not absorb moisture from the concrete. On a 5-mile haul the loss in slump is only ¼ in.

So far no salesmen have been used as there has been more business than the plant could handle. The plant superintendent has a large circle of acquaintances who are in the construction business and these men were informed that they could buy reliable, ready mixed concrete cheaper than they themselves could mix it. That was the only advertising required to put the enterprise on a paying basis.

Before an order is taken inquiries are made to determine whether or not the purchaser knows how to use concrete properly. That is necessary if the plant is to have satisfied customers. Even then an order occasionally slips through which should not have been taken. One afternoon a woman asked that enough concrete to build a walk from her house to her garage be sent out at once. She was asked for dimensions which she later "called back" and gave. She said her father knew all about concrete and was going to build the walk for her. The load was delivered about 3 p.m. Next morning she called again and said the concrete was no good; that her father was there, ready to build the walk, but the concrete was all hard and he could not use it.

FIG. 3—LOADING COARSE AGGREGATE AT SLAG PIT

Birmingham is a city of nearly 200,000 population and has a little more than the average amount of construction work for a city of that size. Only a small part of the concrete for this construction can be furnished by the Sloss-Sheffield ready mixed concrete plant. But, even for such a large market, capacity production was reached in a surprisingly short time, which seems to indicate that there are hundreds of other cities, both larger and smaller than Birmingham, where commercial mixing plants would prove a paying enterprise.

Features in Wood-Preservation Development

Experiments and Improvements in Preservative Methods—Creosote, Petroleum and Zinc—Ties, Poles and Car Lumber

BOTH preservatives and preservative treatment of timber in practical and economic aspects were included in the proceedings of the Cleveland meeting of the American Wood Preservers' Association. The following abstracts indicate the main conclusions:

Douglas Fir—Three specifications dealing with this material included the treatment of ties with zinc-chloride and with creosote, and also the creosoting of piles. The latter requires a minimum absorption of 12 lb. per cubic foot for the full-cell process on piles to be used in sea water, and 8 lb. for the empty-cell process on piles for use in fresh water or inland work. A minimum penetration of ¾, 1 and 1 in. of dark oil is required for treatment with 12, 14 and 16 lb. of creosote respectively.

Zinc-Treated Ties—A paper by Thomas S. Stevens, signal engineer of the Santa Fé Ry., stated that the use of zinc treatment for ties has been abandoned by that road on account of serious troubles with track circuits being interrupted by the metallic salts in such ties. Creosoted ties which have not been properly seasoned may cause similar trouble for a short time if used in large quantities. There is the problem, therefore, not only of timber preservation but of effecting this in such a way as to eliminate or minimize possible harmful results.

Steam Treatment—Experiments on steaming 18-ft. green southern yellow-pine poles having 6 to 7-in. butts indicate that increase in the steaming period decreases the time required for the pressure period, especially with charges steamed for 8 to 10 hours. On the other hand, the latter decrease does not compensate for the former increase, though this might be the case with larger poles. With ties, steaming did not increase the net absorption to any extent.

Car Lumber—There is increasing use of treated wood in railway car construction, but where water-solutions are used the moisture content of the treated wood must be reduced to that of the original kiln-dry condition in order to avoid trouble with painting. The use of sodium fluoride is suggested where odor from the treating medium would be objectionable. It requires no special equipment.

Petroleum as a Preservative—A committee points out that specifications for treatment with preservative mixtures containing petroleum cannot be prepared until there is an approved specification for the petroleum to be used. Not only do different plants use different oils, but some mixtures throw down a heavy sludge that puts the heating coils out of commission, while others carry a high water content which cannot be separated without the application of heat. As to zinc-petroleum treatment, recommendation of the two-process method should be withheld until it can be determined if the present trials of a zinc-petroleum emulsion prove satisfactory. Improved methods of analysis are necessary to determine accurately the percentage of creosote in petroleum-creosote mixtures.

Low-Temperature Tar—Although the production of tar from low-temperature carbonization of coal is not yet of such extent as to be a factor in the supply of wood preservatives, it is of sufficient importance to warrant attention. The tar or tar-distillate has been used experimentally in wood preserving and large quantities of the tar are held in storage awaiting further development.

Non-Pressure Treatment of Poles—Proposed specifications include the puncturing of the ground-line area of the pole by means of power-driven devices making clean cut incisions not more than ½ or ⅝ in. deep. They include also the alternatives of a 15-minute hot bath and an 8-hour treatment combining a 5- to 6-hour hot bath and a subsequent 2- to 3-hour cold bath.

Temperature and Viscosity of Preservatives—That there is a pronounced relation between the temperature-viscosity condition of preservatives and the penetration and absorption of these preservatives by the wood is indicated by experiments reviewed by J. D. McNeal, an engineer of the U. S. Forest Products Laboratory at Madison, Wis. Although zinc-chloride is not sensibly viscous, yet solution temperature is one of the most important factors affecting its absorption and penetration. The comparatively high viscosity of oils at ordinary temperatures has suggested the heating of such oils during the treating process, but beyond that little has been known as to the influence of viscosity or temperature upon the results of the treatment. It now appears, however, that this relation may be expressed by a mathematical equation. Small changes in viscosity obtained by a given temperature change above a high temperature have a much greater influence on penetration than the larger changes in viscosity produced by a similar temperature change at lower temperatures.

Timber Preservation and Forestry—That preservative treatment of wood is helping towards a better permanent use of the forest resources was pointed out by Professor R. W. Smith, New York State College of Forestry, who stated that making wood give three to five times its ordinary life is equivalent to the growing of trees. On the basis that a well treated tie will average three times the life of an untreated tie, each of the 60,000,000 ties now being treated annually has saved two ties in the forest or the equivalent in timber available for other purposes.

Will Hole Through Moffat Tunnel in July, 1926

Notes on Construction Progress and Conditions to Date, Construction Being More Than Three-Fourths Finished

BY C. A. BETTS
Office Engineer, Moffat Tunnel Commission, Denver, Colo.

A general description of the construction plan and methods employed in building the Moffat Tunnel in Colorado was published in Engineering News-Record, June 11, 1925, p. 966. The following notes give the record of further experience with the methods there described and tell of the progress being made.—EDITOR.

TEN miles of 8x8-ft. headings and 3.2 miles of 16x24-ft. single-track full section have been completed up to February 15 on the Moffat Tunnel. The tunnel was then 66 per cent finished after 26 months' work on a 46-month contract, which calls for completion by July 20, 1927. At the present rate of progress the main headings should be holed through in July, 1926. Both the water tunnel and the railroad tunnel main headings from the east portal have reached the end of the rising 0.3 per cent grade, 2,800 ft. under the crest of the Continental Divide, and have started on a descending 0.8 per cent grade to meet the headings pushing eastward on a similar grade from the west portal. To date, progress, in feet, has been:

Item	East	West	Total	Per Cent Finished
Water tunnel	14,720	11,625	26,345	80
Main heading	14,715	11,600	26,315	81
Crosscuts	567	441	1,008	77
R.R. (full size)	12,350	5,141	17,491	54

Geology—The east headings are still in the solid granite and gneiss which have prevailed from the start and the west headings at 11,625 ft. in, and under 1,200 ft. cover, are still in badly shattered gneiss and schist. It is not possible to predict how far this heavy ground, which is adding from $100 to $200 per foot to the cost of the work, will persist. It is obvious, however, that surface influences extend down 1,200 ft. to the tunnel headings which have passed through wet seams under all streams, lakes and swamps and which still have to pass under Ranch Creek on the western slope of the Continental Divide.

Steel I-Beam Wall Plates—In lining the seamy ground where very loose rock was met, 5-segment arches placed on 2-ft. centers have replaced the 3-segment arches spaced 2 to 5 ft. This allowed reinforcing sets to be placed in the 1-ft. open space between if signs of distress showed in the 5-segment sets, and if, in turn, the continual measurements, checks and inspections showed movement or cracks in this skin-tight timbering, the 12x12-in. Oregon fir posts were replaced by 12x18-in. posts. In some places double timber arches, including a total depth of posts of 30 in. have been required to hold the ground. There is no known way of predetermining the stress and strain to which the timber lining will be subjected, but the fact that 12x12-in. Oregon fir wall plates and posts have failed by shearing and by bending determines roughly the unit stresses that have developed. Because of the tendency of 12x12-in. wall plates to rotate under pressure, 12-in. I-beam wall plates laid flat were substituted with marked success. Their function is primarily to assist in the placing of the roof arches and the posts and for this they have the advantage of stability and rigidity in addition to ease of handling. Holes are cut in the web to drain off any water that collects in the trough formed by the horizontal position of the I-beams.

Traveling Cantilever Needle Bar—Top headings followed by top widenings and double or single benching, as well as center heading with "jumbo" sets for trapping the muck from the top widening into cars have been used in the timbered sections, as shown in the illustration, but since the introduction of the traveling cantilever needle bar all of the bench below the wall plates (16 ft.) has been excavated in one operation. This needle bar has successfully held the wall plates and roof timbers tightly in place while from 10 to 20 ft. of full bench have been drilled, shot and mucked by the air shovel and the 19-ft. posts have been set. It has withstood cave-ins beyond the wall plates and lagging and has shown no signs of distress when overhanging more than one-third of its 60-ft. length beyond the bench on which it rests. After the posts have been set the I-beam side-arms which support the wall plates are drawn in and the girder carrying lights, wiring and powerful jacks is pulled ahead by the electric hoist on its forward end to a new position on the bench where the process of supporting roof timbers is repeated.

Fungus—Fungus appeared on the damp timbers, especially the ribs, when air became sluggish along the roof, so that it has been found necessary to creosote all roof timbers. The plan of framing and dapping timbers before bringing them into the tunnel, it has been found, saves time and prevents traffic congestion.

Gutters—A new operation is to put in concrete gutters to serve the dual purpose of drainage ditches and footings to prevent the kicking in of posts as the ground softens upon exposure to air and moisture. Eventually these footings will become part of the permanent concrete lining if it is found to be necessary.

Gunite Lining—In the hard rock at the east end the system of twin headings with ring drilling has given as high as 1,000 ft. per month progress. All seams that might become dangerous when exposed to the air have been either timbered or given a coat of gunite ½ to 5 in. thick to prevent scaling. The roof timbering in some cases has been carried only to the wall plates which were notched into the solid rock; while in other cases, where softer conditions prevail, plumb posts have been set. To date, however, all of the heavy pressures encountered have been at the west end.

Water Tunnel as Service Tunnel—The water tunnel, 75 ft. to the south and parallel with the center heading, has relieved the railroad tunnel of practically all transportation, service piping and wiring, except that at the bench. The value of this service tunnel in speeding up the 16x24-ft. full-section cut by providing numerous simultaneous main heading operations, has led to its being used to expedite widening operations at the west end by opening up a second full-size enlargement well ahead of the bench. In contrast to the ring shooting enlargement in solid rock, where two 8-hour shifts can readily catch up with the three shifts in the heading, the enlargement operation in soft ground lags behind

TOP WIDENING BY TRAPPING THROUGH JUMBO SET TO CARS IN CENTER HEADING

the headings, so that in order to insure early completion of the job, with its $1,000 a day bonus, additional benches must be worked, bringing the muck out through crosscuts and water tunnel. There are now ten crosscuts between the tunnels at the east end and eight at the west end. The average distance between crosscuts is 1,500 ft. As traffic becomes more congested with the progress of the work, sidings for empties are added near the last crosscut. A niche for the motor generator set which converts 2,200-volt a.c. to 250-volt d.c. current for the trolley locomotive and nucking machines, is also excavated near the same crosscut.

On an average 450 men have been employed at the west portal and 325 at the east portal. The work has been notably free from serious accidents. The consistent progress made in spite of unforeseen obstacles is attributed to the organization, "safety first" precautions and the admirable camp, commissary and welfare arrangements for the comfort of the men. Colorado miners predominate in the organization which has already made a record of 1,583 ft. of 8x8-ft. heading with three crews, or 40 men, in 30 days.

W. P. Robinson is president of the Moffat Tunnel Commission under the supervision of which the tunnel is being constructed by Hitchcock & Tinkler, contractors. George Lewis is general manager, assisted by the writer as office engineer, and B. G. Coy and J. F. Cohig as resident engineers.

Traffic Relief Recommendations For New York City

Committee Outlines General Principles and Recommends New Organization Provided With Funds to Carry On the Work

THE Advisory Committee on Traffic Relief which was formed as the result of a resolution adopted by the Board of Estimate and Apportionment of New York City on Dec. 22, 1924, made its report on Dec. 28, 1925, at the same time asking that it be relieved from further responsibility in the matter of traffic relief. Its reasons for the latter step were that its work had been conducted with a great deal of difficulty owing, first, to the fact that trouble arose in getting a staff to carry on the investigation and, second, that since its recommendations had been made, it was of the opinion that the "carrying forward of the important task assigned to it required a well equipped organization for the setting up of which no provision of funds has been made."

The committee held seven meetings and gave consideration to the practicability of obtaining relief through further regulation of traffic, to certain specific improvements designed to open up new and needed traffic arteries, and to incidental problems bearing upon the subject. Some of the matters more particularly considered and the recommendations made were:

(1) More stringent traffic laws and ordinances than those now in force, in the opinion of the corporation counsel, could be enacted by the municipal assembly or the Board of Aldermen.

(2) Traffic counts should be made at carefully selected points throughout the city. A map of arterial streets showing upwards of 300 points where such counts should probably be made accompanied the report. The committee recommended that these counts be taken at points about 100 ft. from a street intersection, and it was also the opinion that efforts should be made to classify the vehicles enumerated in so far as is practicable.

(3) Roadway and sidewalk width should be modified by increasing the roadway width of streets 60 ft. wide from 30 ft. as heretofore provided, to 34 ft., the added width to be withdrawn from the sidewalk with corresponding changes in streets from 50 to 75 ft. wide.

(4) Subway kiosks should be removed from the curb and placed either alongside the building line or preferably within an adjacent building. Material relief would result from the removal of elevated railroad columns from the roadways and of surface railway crossovers and turn-back switches, all of which impede traffic.

(5) It was not believed by the committee that the length of time during which vehicles remain stationary (i.e. parked) is an important element of the traffic problem in general because any stoppage whatever largely destroys the usefulness to moving traffic of the particular lane in which the vehicle is standing. Recommendations considered but not made definite were the limiting of some of the north and south arterial streets in the Borough of Manhattan to one-way traffic, to limit parking in one-way streets to one side of such streets, to prohibit the loading or unloading of traffic during certain hours, and to require that trucks be constructed so as to permit both side and end unloading.

(6) Increased restriction of the height of buildings was pointed out to be a method of relieving the steadily increasing traffic load upon the streets. Re-zoning would be difficult but traffic ordinances which would have the effect of imposing upon builders the necessity of providing accommodations within the building for the parking incident to its use might automatically help in the restrictions to building height. The introduction of arcades should be encouraged as offering the most available method for increased street capacity without serious invasion of land values or destruction of valuable property.

(8) Use of containers for the delivery of merchandise was recommended as a means to decrease and eventually to discontinue the use of the public thoroughfare for loading or unloading purposes during the hours of maximum traffic congestion.

(9) A publicity campaign should be instituted with a view to encouraging the construction of parking garages. From the opinion rendered by the corporation counsel it would appear that this relief can be brought about only through private activity.

(10) The time has arrived when apportionment of roadway width should be definitely based upon traffic lanes, these in turn being regulated by the size of the vehicles using them. A study was made with a view to formulating regulations for maximum dimensions and more particularly as to the width of motor vehicles that will be permitted to operate upon the public streets.

(11) An express street of adequate width should be built along the west waterfront in the boroughs of Manhattan and the Bronx with an extension along the city line to connect parkways in Westchester County.

(12) The relief to be obtained from the alteration of the rapid transit structure on the line of Broadway across the Manhattan valley to provide for a vehicular roadway over West 125th St. would not be commensurate with the cost of the work.

(13) In regard to the development of the Hell Gate bridge to serve as a portion of a tri-borough bridge to connect the borough of Queens with the boroughs of Manhattan and the Bronx, Dr. Gustav Lindenthal, consulting engineer and the designer of the structure, stated that the arch span of the bridge is strong enough to carry an upper or highway deck and that no additions are needed on the arch span for sidewalks since the unused space outside the arches on the railroad can be devoted to this purpose. The committee requested the chief engineer of the Department of Plant and Structures to investigate the matter more fully to the end that the merits of the project may be wholly developed before attempting to open negotiations with the railroad company as to the terms and conditions under which the existing Hell Gate structure could be used.

(14) An interborough parkway improvement is proposed to afford a connection between Eastern Parkway in Brooklyn and Forest Park in Queens.

The Advisory Committee on Traffic Relief consisted of Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, chairman; Richard E. Enright, police commissioner; William Wirt Mills, commissioner, department of plant and structures; George P. Nicholson, corporation counsel; John F. Sullivan, consulting engineer, Borough of Manhattan; Philip P. Farley, consulting engineer, Borough of Brooklyn; Josiah H. Fitch, chief engineer, Borough of the Bronx; Charles U. Powell, engineer in charge, topographical bureau, Borough of Queens; Theodor S. Oxholm, consulting engineer, Borough of Richmond.

Flow Tests of Old Cast-Iron Water Mains, Chicago Water-Works

Pipe in Use 9 to 36 Years Show Low Friction Loss and That Coefficient Should Be Based on Corrosivity of Water

By J. B. Eddy
Engineer, Water Pipe Extension Division, Chicago Water Department

In the design of cast-iron feeder mains the most important factor to be considered is the friction coefficient, *C*. If too high a coefficient is used in computations there will be an excessive loss of head when the main is worked to capacity, resulting either in low pressure to the consumer or waste of power at the pumping station in order to carry a high pressure to compensate for the friction loss. If too small a coefficient is used money may be wasted in laying a larger main than is actually needed. The tendency in the past has been to err in using coefficients too low, as many standard tables in common use have been constructed that provide for a definite increase in loss of head with the age of the pipe. While this error has been on the side of safety, as far as carrying capacity is concerned, it may cause a needless expenditure of money. (See Art. 116, Merriman's "Treatise on Hydraulics.")

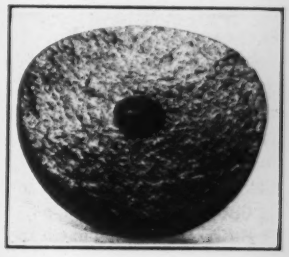
OUTSIDE OF CAST-IRON PIPE USED 31 YEARS
Specimen cut from 36-in. main laid in October, 1893, in 75th St. at Yates Ave., showing the shiny surface of coating intact

Experience has shown that whether or not there is an increase in friction head with age depends entirely upon the quality of the water conveyed. In some localities where extremely soft waters are found tuberculation will occur and unless steps are taken to clean the pipe lines with some degree of regularity high friction heads will ultimately result. In other places tuberculation is entirely absent and after years of service the interior of the pipe is approximately in the same condition as when first laid.

Cast-iron mains in the Chicago water system are typical of the latter class. Examinations and test indicate that age has little or no effect on their carrying capacity.

The tabulation that follows shows the results of some of the tests made over a period from 1907 to date. These tests have been made carefully, using pitometers to measure the velocities and calibrated gages to measure pressure losses. In order to eliminate errors in gage readings it has been customary to divide tests into two periods and to exchange gages at reading points between periods.

The condition of the mains indicated by the tests is borne out by examination of the interior of many pipes. Pieces cut out of old mains when connections are made to them show an interior that would be expected to give results equal to those obtained with new pipe. About 400 taps, from 3 to 12 in. in diameter, are made yearly on mains, some of which have been more than fifty years in service. Pieces cut out are marked with a tag showing location, size of main and date laid and are submitted to the engineer for examination. These pieces are kept as a record of both the inside and outside condition of the pipe. Many of the pieces cut from the older mains are to all appearances as good as those cut out of mains laid within the last five years. The glossy condition of the coat of paint is quite plainly seen in the pictures of two of these pieces.



INSIDE OF CAST-IRON PIPE USED 35 YEARS
Cut from 12-in. main laid in April, 1889, in Roosevelt Road at Troy St. No deep tuberculations found

As a result of these tests and examinations made by the Chicago Water Department, it is customary in figuring pipe sizes for feeder mains to assume that the pipe coefficient will not change with age.

TYPICAL FRICTION LOSSES IN CAST-IRON MAINS, CHICAGO WATER-WORKS

Tests Made from 1907 to 1925 by Water-pipe Extension Division, Chicago Water Department

Location	Diameter, Inches	Years of Service	Length, Feet	Results Shown by the Tests: Velocity Ft. Per Sec.	Loss of Head, Ft.	Coef. in Chezy Formula	Coef. in Hazen & Williams Formula
66th St. and Stony Island Ave. to 51st St. and Harper Ave.	36	9	10,900*	5.33	18.3	150	152.6
67th St. and Stony Island Ave. to Cottage Grove Ave.	48	10	5,300	5.4	6.1	159	158.3
Oglesby Ave. and 68th St. to Stony Island Ave. and 67th St.	48	10	5,300†	7.0	11.8	149	143.0
66th St. and Cottage Grove Ave. to 66th St. and State Street	36	24	6,415‡	4.12	8.24	133	136.7
67th St. and Cottage Grove Ave. to 67th St. and State Street	30	30+	4,950	5.3	12.53	133	136.2
Oak St., Clark St. to Cambridge St.	24	25+	2,830	2.61	2.81	117	138.1
51st St., Wabash Ave. to Halsted St.	20	15	5,470	3.21	8.68	125	137.5
67th St. and Cottage Grove Ave. to 67th St. and State Street	16	30+	5,250	3.89	14.3	130	143.4

*Two right-angle bends in line. †One right-angle bend in line. ‡ Four right-angle bends in line.

A New Port Planned for Brazil

Owing to the congestion of railway and shipping traffic at Santos, Brazil, which is the principal port of the coffee export business, the Sao Paulo Ry. Co. proposes to establish an auxiliary port at Sao Sebastiao, about 60 miles eastward. This would be served by a branch railway from Campinas. The port and harbor works are estimated to cost about $100,000,000.

Anchorage and Bearing Details of Rigolets Bridge; L. & N. R. R.

Removable Anchor Bolts Facilitate Landing Spans on Piers—Oil Boxes for Roller Bearings—Bottom Laterals

STABILITY against high wind pressures was an important factor in the design of the new bridge carrying the Louisville & Nashville R.R. over the Great Rigolets pass or channel on the gulf coast, so that anchorages somewhat heavier than those ordinarily used for such structures were designed to hold the spans in place upon the piers. This bridge, consisting of eight through-truss spans of 330 ft. and a 414-ft. swing span, is not only in an exposed position on the coast, but is in a district subject to tropical hurricanes, as noted in *Engineering News-Record* of Oct. 18, 1923, p. 626.

Both the superstructures and the anchorages were designed to stand a wind pressure of 50 lb. per square foot on the structure when unloaded and 30 lb. when loaded. For each span, the 50-lb. pressure was taken as applied to the exposed area of the two trusses and the elevation of the floor system. Computations of stress conditions showed that the anchor bolts would not be required to take uplift from the wind pressure moments, but only the shear due to the wind pressure. Additional precaution was taken, however, by proportioning the anchor bolts so as to take uplift that might occur with wind pressures somewhat higher than 50 lb. per square foot.

Anchor Bolts—While the tops of the piers were being completed, 6-in. pipes were built into the concrete, with the 2-in. anchor bolts attached, as shown in Fig. 1. Each bolt was in two parts, connected by a sleeve nut, the lower end of the nut being hammered into a notch cut in the lower section of the bolt, so that the nut could not turn. This arrangement was adopted to enable the upper parts of the bolts to be removed when the span was floated into place. These removable bolts had the ends pointed to facilitate entering them into the sleeve nuts after the spans were seated. With the span finally seated, the bolts were replaced through the holes in the cast-steel end shoes and were screwed home into the sleeve nuts, after which the pipes were filled with cement grout. Although the anchor bolts were built into the piers long before the superstructures were placed, they were so accurately located that there was no difficulty in adjusting the shoes of the spans over the anchor bolts in the shoe castings on the piers.

It will be seen that at the bottom of the pipe the bolt is centered by an inside washer 4x4-in., while a 1½-in. anchor plate 8 in. square is held against the end of the pipe by a nut. At the top of the pipe, the bolt was centered temporarily by a heavy washer or cap 6½ in. in diameter, turned with a shoulder so that the lower part of the cap fitted inside the pipe. The caps were removed after the pipes had been grouted into the piers.

These anchors were required to be set with the top of the 6-in. pipe exactly 1½ in. below the final elevation of the underside of the cast steel shoes. The tops of the sleeve nuts would then be 2 in. below the shoes. Until the time for placing the shoes, the nuts on the anchor bolts were screwed down on wood blocks bored to fit over the bolts.

End Bearings—In all the end bearings, provision is made for holding each bridge shoe laterally in the shoe anchored to the pier. It will be seen from Fig. 2 that the upper casting or bridge shoe is formed with three ribs which enter corresponding recesses in the lower casting. Both castings are machined to give a continuous bearing for the 6-in. shoe pin, which passes through holes in the two castings and thus gives a positive hold against uplift of the span. In the lower castings, the 2-in. anchor bolts pass through 3-in. holes which permitted adjusting the position of the bolt, the space around each bolt being filled finally with melted babbit metal.

At the expansion ends, the bearings have rockers or segmental rollers 8 in. high, with toothed bars on the ends of the outer rollers to engage with sockets in the top and bottom plates, so as to hold the rollers in place.

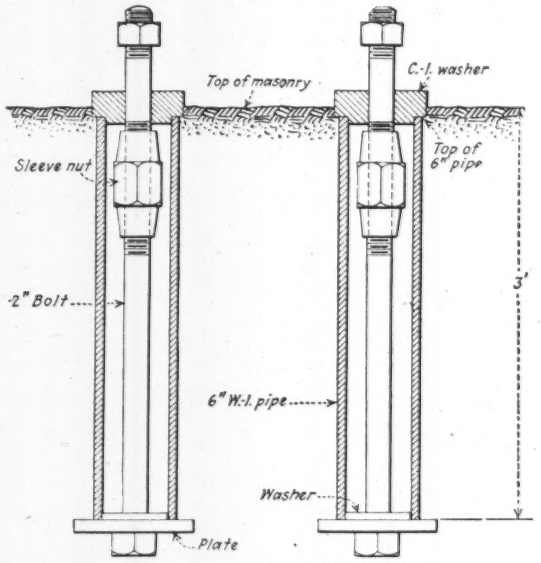


FIG. 1—ANCHOR BOLTS HAVE REMOVABLE SECTIONS

To prevent bolting the shoes too tightly upon the rollers, pipe sleeves of the same height as the latter were placed on the anchor bolts.

Oil Boxes for Expansion Bearings—A special feature of this bridge is the enclosing of the end roller or rocker bearings in oil boxes to prevent corrosion and to facilitate free movement of the segmental rollers. This arrangement, shown in Fig. 2, also prevents cinders and trash from getting between or under the rollers and obstructing their movement. The boxes are of ¼-in. plate and are fastened to the cast-steel shoe by stud bolts. A 1¼-in. pipe with screw cap provides for filling the box, while ¾-in. drain pipes provide for drawing off the oil when necessary. Gaskets of sheet cork are used in all joints to prevent leakage of oil.

Drawspan Bearings—To hold the ends of the swing span against wind pressure, the end wedges are made to slide between lugs on the lower castings which support the wedges when the span is closed. These lugs, therefore, provide a lateral bearing for the wedges to resist wind pressure. The end castings were placed so accurately on the piers that the span can be changed end for end without affecting its adjustments.

In a draw-span 414 ft. long, situated like that of the Rigolets Bridge, the south truss gets heated more than

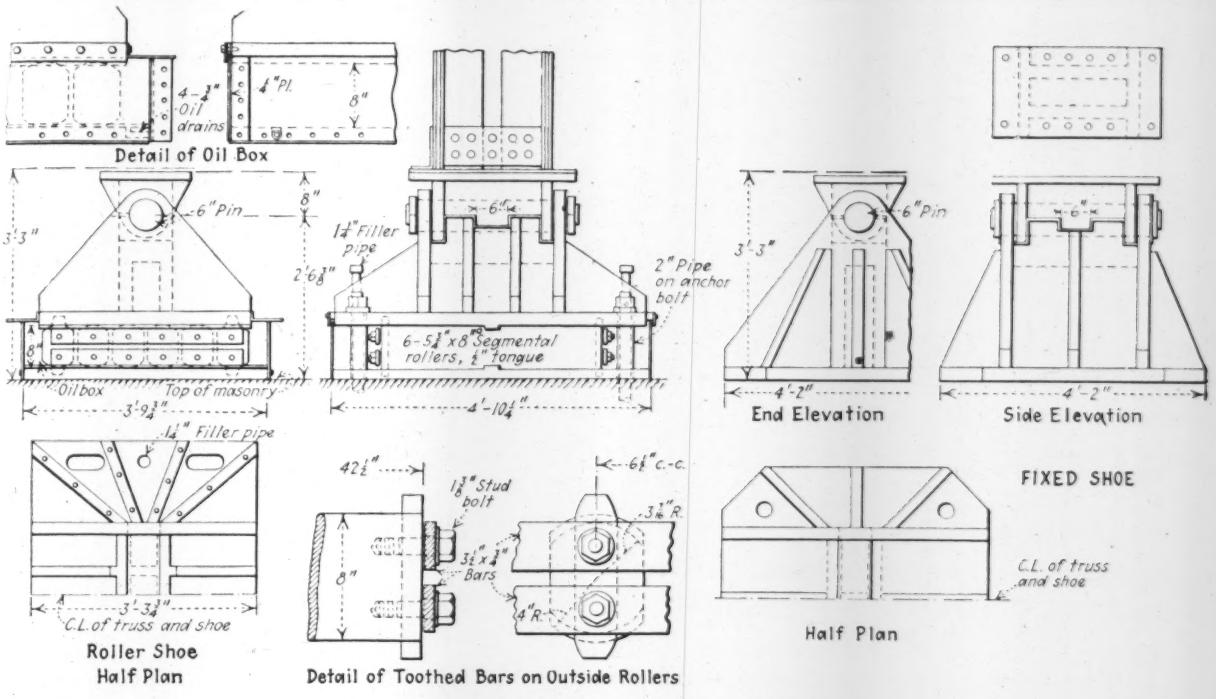


FIG. 2—OIL BOX ENCLOSING END BEARING

the north truss, causing the span to warp to some extent. The greatest variation found since the draw span was put in service on June 10, 1925, has been 1½ in. To provide for such warping, there are end guides which bring the structure into line as it closes. The mitered rails also move in guides, so that these rails on the drawspan line up accurately with the mitered rails on the adjacent fixed spans. For the same reason, the wedges on the span and the wedges on the approaches have their ends tapered.

Floor System and Laterals—In the fixed spans, double floorbeams are used at about the one-third points, or at panel points L4, in order to reduce secondary stresses in the floorbeams due to elongation of the bottom chords under live-load stress. The bottom laterals are attached to the track stringers on each side of panel points L2 and L6. They are not attached to the stringers at other points as it was important to reduce the stresses in the laterals, due to the extension of bottom chord under live-load.

The arrangement of these laterals where they pass under the stringers but are not attached to them is shown in Fig. 3. It will be seen that the lateral is a plate 12x⅝-in. with a 12x⅝-in. plate stitch-riveted to the upper side so as to form a contact or bearing against the bottom-chord angles of the stringers. On each side of the lateral is a ⅜-in. filler plate riveted to the stringer, these fillers forming guides. To the two fillers is riveted a 14x⅜-in. bottom plate extending under the lateral and in contact with it. In this way the lateral is held from beneath and on both sides, the attachment being tight enough to prevent vibration and rattling during the passage of trains, but loose enough to allow the lateral to slip as the chords change in length.

The superstructure of the Rigolets Bridge was fabricated and erected by the American Bridge Co. The design and construction were under the direction of W. H. Courtenay, chief engineer of the Louisville & Nashville R.R.; the special details necessary to provide for heavy wind pressure were worked out under the supervision of J. M. Salmon, bridge engineer of the railroad.

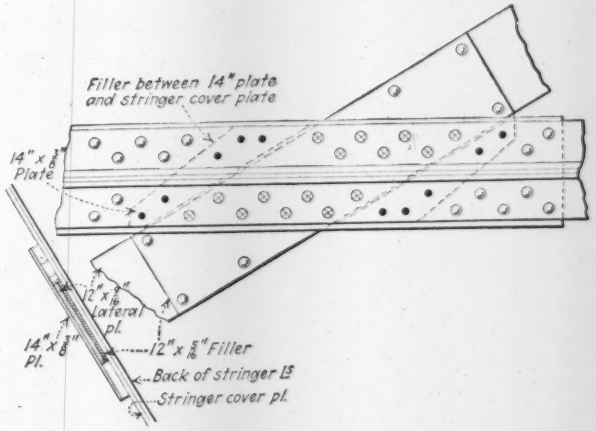


FIG. 3—LATERAL PASSING UNDER TRACK STRINGER

Water Charge for Construction Uses

The city of Mobile, Ala., imposes a charge of 6c. per cubic yard of concrete for water taken by construction companies from city mains. This is in lieu of a fire hydrant rental. A charge of 12½c. per thousand of brick for masonry structure is also made. For concrete work the charge amounts to about one cent per square yard for a 6-in. slab. It is probable some change will be made in this schedule of charges, as they are believed to be too high. However, some charge is necessary to curb needless waste of water for construction uses.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Suspension Bridges and Their Cables

The historic firm of John A. Roebling's Sons Co. (Trenton, N. J.) makes a noteworthy contribution to the scanty literature of suspension-bridge construction in a monograph just issued, which though nominally a trade publication yet claims a permanent place in the engineer's library. The larger part of the book consists of halftone reproductions of views taken during the construction of the Bear Mountain-Hudson River bridge, bearing particularly on the cable spinning and wrapping and auxiliary work. This is preceded by two dozen pages of text giving a valuable mass of information on suspension bridges, on cable construction, and on tests of wires and cables made to bring out important information bearing on the strength of parallel-wire cables as used in suspension bridges.

As the earliest suspension bridge of magnitude built by the founder of the company the book names the Pittsburgh aqueduct bridge built at Pittsburgh in 1844 to carry the Pennsylvania Canal across the Allegheny River. It was followed by four or five other aqueduct bridges within the next six years, and then came the Niagara Falls bridge of 1854, which became known the world over. A number of other structures were followed by the famous Brooklyn bridge, opened in 1883, and later the more recent bridges, terminating with the Rondout Creek and Bear Mountain-Hudson River bridges. The latter, it is well to remember, is the longest suspension bridge yet completed; its span of 1,632 ft. between towers will be exceeded only by the 1,750-ft. span of the Delaware River bridge connecting Philadelphia and Camden.

In its all-too-brief discussion of the cable-spinning operations, the text brings out the significant fact, so important in assigning to the suspension type a new place in the field of modern long-span bridge construction, that cable spinning has been speeded up most remarkably since the time of the Brooklyn bridge. The operation took 21 months for the Brooklyn bridge, 7 months for the Williamsburg bridge, and only 3½ months for the Bear Mountain bridge, with larger cables than those of the other two. This advance has been achieved without essential change of system, merely with painstaking and ingenious improvement in detail. One might wish that the engineers who contributed to the main conceptions or essential improvements of structure and process had been mentioned. The resulting human touch and contact with men who lived and worked in this field would have made the appeal of the book even stronger.

World-Wide Review of Civil Flying

CIVIL AVIATION: A Report by the Joint Committee on Civil Aviation of the U. S. Department of Commerce and the American Engineering Council. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 189; 31 charts, maps and diagrams, and many tables of statistics. $2.50.

About all the available information on opportunities in commercial aviation is presented in this report. As a comprehensive review of civil flying in all countries of the world the book should prove of great value to any organization which contemplates entering this field. Its interest to civil engineers, however, is merely popular. Subjects covered include the reliability and safety of aviation, geographic and traffic conditions, industrial applications, government aid, air legislation, landing fields and airways, flying equipment, aviation insurance and investment aspects.

Briefed Information on Concrete Behavior

RESEARCHES IN CONCRETE—By W. K. Hatt, Head of School of Engineering, Purdue University. Lafayette, Ind.: Purdue University. Paper; 6 x 9 in.; pp. 102; line cuts.

Accumulation of knowledge of the properties of materials is a slow process. Individuals make little steps forward into the unknown and record somewhere what they learn. Other individuals seeking the same information proceed anew to travel the same paths and record in their turn what they learn. Gradually there grows up a great body of experience, all recorded but rarely collected and almost as rarely consulted by those who proceed again to venture into research for new knowledge. Professor Hatt in this little pamphlet has endeavored to record in small compass an arduous effort to collect and collate the numerous researches into further knowledge on concrete. His record is a valuable addition to the workshop of the future investigator, but more than that, it is a compendium of briefed information on concrete behavior for consultation by the concrete user.

The author is himself sensible of the incompleteness of the record, for he says in his preface that he is here reviewing "the status of some of the important fundamental researches in unsettled fields. No attempt is made to cover the entire field. Research in the basic material, portland cement, is not included. The design of structure is omitted. Many matters connected with design of concrete mixers and manufacture of concrete, if not widely applied or well determined as a result of recent intensive study, these are very incompletely reviewed. It is the purpose of the author to present the results of investigation rather than to draw conclusions."

In spite of this apology, the pamphlet has much valuable information. It covers in admirable abstract the results of investigations into expansion and contraction of concrete, expansion and contraction of structures in service, strength of dry and wet hardened concrete, flexibility of concrete, elasticity of concrete, plastic flow of concrete, permeability, heat transmission through concrete, fire resistance of concrete, permanence of steel in concrete, reinforcing steel and bond, effect of age upon strength of concrete, amount of mixing water, time of mixing, control of steel in concrete, comparison of field and laboratory tests, soundness tests of coarse aggregate, and screenings as fine aggregate. It is preceded by a historical résumé of concrete research and followed by a very extensive bibliography of research in concrete. The net result of reading the pamphlet is an appreciation on the part of the concrete

user of the vast amount of study that has been given to his material and, as the author says, the dispelling of "any impression of mystery in the behavior of portland cement concrete; the usual available information will generally explain unexpected happenings and can avoid practices that lead to disappointment."

Needs Revision and Correction

REVIEWED BY ROBERT JOB

Vice-President Milton Hersey Co., Ltd., Industrial Chemists, Engineers and Inspectors, Montreal, P. Q.

TESTS FOR RAILWAY MATERIAL AND EQUIPMENT—By Henry Knauer. [Railwayman's Handbook Series.] New York: Simmons-Boardman Publishing Co. Flexible; 5 x 8 in.; pp. 257; 31 line cuts and halftones.

Mr. Knauer's book is addressed to all persons who are called upon in any way to test or pass upon the merits of railroad materials and appliances. It gives information regarding tests and treatment of water, tests of paint, varnish, oils, rubber goods, cement, iron and steel, gas analysis, oil burning, quality of steam, steam boiler tests, locomotive road tests, and many other subjects. The author is a mechanical engineer and gives good information regarding mechanical matters, such as steam boiler tests, etc. Unfortunately, however, the chemical statements which he makes are frequently incorrect and would lead to serious trouble if followed. There are so many errors that in the present review it will be possible to mention only a few.

Under cast iron, p. 107, it is stated that the percentage composition of car wheels should be: Silicon, 1.25 to 2.00; phosphorus, 0.40 to 1.00; sulphur, not more than 0.06. A wheel of this composition would be so soft and weak that it would be unsafe and should never be put in service; in fact, it would fail under the physical tests. The maximum for sulphur is far below current practice.

A number of other misstatements are made in connection with iron, as for instance, in general iron castings manganese up to 8 per cent is permitted, although not over 1.25 per cent is ordinarily present and generally much less. Also under piston ring metal, 0.90 per cent phosphorus is called for while only about half of that percentage should be present. In malleable iron the sulphur is stated to be 1.10 per cent which is far in excess of the proper amount.

Equally incorrect statements are found in the descriptions of signal oil, car oil and linseed oil. Under varnish, an obsolete definition is given. China wood oil is classed as an adulterant, which is far from being the case for it may properly be described as being the very basis of present-day varnish manufacture.

For the reasons stated, the book cannot be recommended until after thorough revision and correction.

Huge Task Well and Interestingly Done

HISTORY OF ECONOMIC PROGRESS IN THE UNITED STATES—By Walter W. Jennings, Ph.D., Associate Professor of Economic History in the University of Kentucky. New York: Thomas Y. Crowell Co. Cloth; 6 x 9 in.; pp. 819; 1 map, statistical tables, bibliography. $4, postage extra.

Admiration and pity rival each other as one contemplates the immense and ably done task of the author of this book on the one hand and on the other the student confronted with this vast amount of information on the economic progress of the United States. We say student for the book appears to be designed for college use although like many if not most of the best of recent college texts this one is well suited to any intelligent reader. Nor need it be taken in one dose. Commerce, for instance, may be followed from period to period and the other main topics passed over for the time or for all time.

Chronologically, the book is divided into five periods: Colonial, 1492-1775; Winning Political and Commercial Independence, 1776-1815; Expansion, 1816-60; War and Recovery, 1861-1900; The Twentieth Century. Under each period, so as far as applicable, the plan is to take up population, agriculture, manufactures, commerce, banking and currency, the tariff, and labor, the last two first appearing as chapter heads in the 1816-60 section, where also there is for the first and only time a chapter on internal improvements. In the latest period the trusts and combinations and conservation of natural resources appear. Statistics, in tabular form, are wisely grouped in an appendix and even so are kept within 18 pp. There is a brief but sufficient classified bibliography. All concerned deserve commendation for the comprehensive index of 40 pp. Not among the least of the merits of the book is its well maintained human and literary interest.

The Case for Superpower

SUPERPOWER: ITS GENESIS AND FUTURE—By William Spencer Murray, Murray & Flood, Engineers; Engineering Chairman, U. S. Government Superpower Survey. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 237; 5 insert map plates, 25 line charts. $3.

The engineering bases for development of "superpower" were adequately given by Mr. Murray and his associates in the well-known report following the Superpower Survey made in 1921. That report was included in Congressional Paper 123 of the United States Geological Survey. What Mr. Murray is presenting in the book noted here is a philosophical discussion of superpower and a justification of it on economic and social grounds.

He therefore surveys the past of power, the development of electricity and the electric utility companies, and discusses the question of ownership with a decided conclusion in favor of the existing systems of private control. He then recites fairly briefly the history of the inception of superpower and the development of the survey, and briefly states its conclusions. Following chapters relate to the probable demand for superpower in railway electrification and to discussions of the political aspects of superpower, so far as it affects interstate relations, the Interstate Commerce Commission, public service commissions, and the Federal Power Commission. Finally, there is a chapter on financing superpower with an enthusiastic endorsement of all of the modern embellishments of power finance, including holding companies.

Superpower is somewhat more than mere interconnecting of power lines. It involves a standardization of engineering design and operation, a changed attitude of the people toward the business of power production and, although Mr. Murray nowhere admits this possibility, a changed attitude of some of the leaders of the utility companies toward their obligations to the public. So violent a disarrangement of present conditions cannot be expected to transpire immediately. It is well, therefore, that during the possible transformation both the public and the producer should inform themselves as to what is lying ahead in the new era of electrical development. For this purpose, Mr. Murray's book is well adapted.

The New Knowledge on Ventilation

FRESH AIR AND VENTILATION—By C.-E. A. Winslow, Professor of Public Health, Yale School of Medicine; Chairman, New York State Commission of Ventilation. New York: E. P. Dutton & Co. Cloth; 5x8 in.; pp. 182. $2.

Advances in the theory of ventilation and the best means of putting its teachings into effect have been rapid of late. This has been due largely to the work of the New York State Commission on Ventilation, whose elaborate report was noticed in these columns on July 19, 1923, p. 108. The chairman of that commission, Prof. C.-E. A. Winslow, has put into small compass the main data and conclusions of the report and brought the subject down to date. The present volume is designed for general reading as well as for physicians, engineers, architects and health officers. It is addressed particularly to legislators and administrative officers who make laws and regulations controlling the ventilation of schools and other public buildings. Such laws and rules are now in sad need of revision, the author says, or lacking in many States of the Union.

The book takes up the relations of the atmosphere to human health and comfort; good ventilation and how to get it; special problems of factory ventilation; climate and season, and the hygiene of the skin.

Wide circulation, careful study, and a following of the teachings of the book would be of great benefit throughout this or any other country whose people spend a large part of their time indoors. Lack of an index is an unpardonable offiense that should not be repeated when a new edition appears.

R. L. Stevenson on Two Engineers

MEMOIR OF FLEEMING JENKIN: RECORDS OF A FAMILY OF ENGINEERS—By Robert Louis Stevenson. (Stevenson's Works, South Seas Edition, Vol. XVI.) New York: Charles Scribner's Sons. Cloth; 5 x 7 in.; pp. 352. $0.90.

By offering single volumes of their new South Seas Edition of the Works of Robert Louis Stevenson separately the publishers have made available at an almost nominal price Stevenson's Memoir of Fleeming Jenkin, under whom as professor of civil engineering at Edinburgh University Stevenson sat (sometimes) and also Stevenson's Life of a Family of Engineers, devoted chiefly to Robert Louis' grandfather, Robert. These works are too little known by engineers, even those who delight in Stevenson as a story writer, poet and essayist.

It is Jenkin as a man that Stevenson himself presents, but he sketches Jenkin's career as an engineering (artisan) apprentice and as an engineer in charge of laying and testing cables, and gives some hints of Jenkin as an inventor and as a partner of Sir William Thomson, afterward Lord Kelvin. A considerable part of the memoir is occupied in letting Jenkin speak for himself, with extracts from Jenkin's diaries—as a boy in Paris, during the Revolution of 1848, and while laying various cables, including entries made in 1869, made while on the Great Eastern, the last sentence of these being "The Americans are charming people."

Of his student days at Edinburgh University and particularly under Jenkin, Stevenson frankly declares: "I was inclined to regard any professor as a joke, and Fleeming as a particularly good joke. . . . I was not able to follow his lectures; I somehow dared not misconduct myself, as was my customary solace; and I refrained from attending." This nearly cost Stevenson his graduation, for although, to quote, "I was a master in the art of extracting a certificate even at the cannon's mouth," he had some anxious moments before he succeeded in this case, and at the end Jenkin's "manner . . . told me plainly what a dirty business we were on. . . . That was the bitter beginning of my love for Fleeming. I never thought lightly of him afterwards."

As has already been said, A Family of Engineers deals almost wholly with Louis' grandfather, Robert, but it contains some interesting notes on Robert's stepfather, Thomas Smith, with whom Robert served a practical apprenticeship, succeeding his elder as engineer to the Commissioners of the Northern Lighthouses, a position he held from 1797 to 1843. It was in this capacity that Robert built the famous Bell Rock Lighthouse (1807-10) on a site submerged at every tide and subjected to high wave action. An almost day-by-day record of this work fills 116 pp. of the volume.

Both sections of this book, and particularly the second, contain notable comments by R. L. Stevenson on engineering as an art and as a science. He noted material differences between the mechanical and the civil engineer. Evidently it was the latter that most appealed to him. Of the civil engineer Stevenson says: "He is always the practical man. The rains, the winds and the waves, the complexity and the fullness of nature, are always before him. He has to deal with the unpredictable . . . In this sort of practice, the engineer has need of some transcendental sense."

British Book on Water Power Engineering

PRACTICAL WATER-POWER ENGINEERING: A Treatment of Technical and Commercial Factors; With Special Reference to Field Work Involving Study of Stream Flow, Pondage Capacity, Developed Waterways, Power Transmission Lines, etc.—By William T. Taylor, M.Am.Soc.C.E., Fellow Am.Inst. Electrical Engrs., M.Inst.C.E., M.I.E.E., Consulting Engineer. New York: D. Van Nostrand Co. Cloth; 6x10 in.; pp. 270; 32 line cuts, inserted charts, 33 tables. $10.

As England has been classed as a country that has been backward in the development of water power, it is rather a surprise to find such a detailed study of the problems connected with water-power development as this one of Mr. Taylor's coming from the British press. But upon further consideration of the subject, it is evident that the very thing which has made the British Isles backward in the development of water power is the cause for such a careful study. The laws of the land and innumerable rights and restrictions affecting the use of water and the alteration of existing conditions in the waterways make it necessary to consider every detail of a water-power project before undertaking development in order to insure its success. The book deals with all the factors of water-power engineering except turbine design—a problem that the author believes is the concern of the manufacturer more than of the engineer studying the power possibilities of any stream. Fundamental hydraulics, rainfall and runoff, stream flow, storage and pondage, selection of power sites and what the author calls the three means of transmitting the energy of the water to the consumer, the gravity conduit, the pressure pipe line, and the transmission line, are all dealt with in considerable detail. Also, there is a chapter on automatically controlled small water-power plants and one on water legislation. The latter is too general to be of much value in this country, except as a matter of general information. One of the best things in the book is a tabulation of all the items of cost entering into a water-power development which is given in the chapter on "Reporting on a Water Power Project."

PUBLICATIONS RECEIVED

REGULATIONS FOR INSTALLING Sprinkler Equipments as recommended by the National Fire Protection Association (40 Central St., Boston, Mass.), are available in revised form.

A SPANISH-ENGLISH EDITION of the text of the American Society for Testing Materials' Standard Specifications for Open-hearth Steel Girder Rails may be obtained from the Superintendent of Documents, Washington, D. C., for 5c.

AN INTERESTING REPRINT from United States Public Health Reports (June 26, 1925) is entitled Studies of Impounded Waters in Relation to Malaria, by E. H. Gage, associate sanitary engineer, U.S.P.H.S. (5c. from Superintendent of Documents, Washington, D. C.).

DISPOSAL OF EXCESS ACTIVATED SLUDGE is the English equivalent of the title of a 25-p. pamphlet (Die Beseitigung des überschüssigen belebten Schlammes bei der Abwasserreinigung) by Dr. F. Sierp, of the Ruhrverband, Essen, Germany, published by Wasser, Berlin-Dahlem, at 1.8 reichmark in Germany.

PORT SERIES Nos. 9 and 10, the first dealing with Charleston, S. C., and Wilmington, N. C., and the second with Savannah and Brunswick, Ga., have been published (50c. and 75c. respectively from Superintendent of Documents, Washington D. C.). The series is the work of the Board of Engineers for Rivers and Harbors in co-operation with the United States Shipping Board.

A CONTRACTOR'S FIELD RECORD BOOK of 128 pp., prepared by Martin A. Melloy, has blank forms for job subdivisions, time distribution, time record for pay roll, material and equipment record, cash receipts and expenditures, and other operating details, the engineers' and architects' certificates for payment, and also forms for lump-sum, cost plus and other contracts. Sold by the author (minimum order, ten copies for $5), 111 West Washington St., Chicago.

TWELVE NATIONAL FOREST RESERVES in the Eastern United States with a total area of 2,584,076 acres, on which there is a reserve of more than five billion feet of timber valued at nearly $6,000,000 in excess of the cost of the land to the United States, have been built up in the past fifteen years according to the report of the National Forest Reserve Commission for the fiscal year 1924-25 now available on application to the Commission (Atlantic Building, Washington, D. C.) as a 34-p pamphlet with halftone plates.

ALL CONCERNED WITH HIGHWAY CONSTRUCTION will be interested in the brief "Standard Specifications for Corrugated Metal Pipe Culverts, Adopted by the American Association of State Highway Officials and Approved by the Secretary of Agriculture for Use in Connection with Federal-Aid Road Work." The specifications have been so condensed that they are brought within less than 5 printed pages (5c. from Superintendent of Documents, Washington, D. C.).

REQUISITES for a Sound System of Assessment for Taxation in accordance with the ideas and practice of the Technical Advisory Corporation (15 Park Row, New York City) are set forth in a 16-p. pamphlet. Summarized, they include a field survey, tax maps, a record card for each property, a unit land value map, tables and graphs of land value factors, tables of cubage values for buildings, according to classification, and finally tables, standards and methods for applying depreciation percentages to buildings.

FOLLOWING A POLICY of combining in a single volume all triangulation data relating to one state, there has just been published "Triangulation in Maryland," edited by Hugh C. Mitchell, mathematician of the U. S. Coast & Geodetic Survey. The volume numbers some 600 pages and includes important vicinity maps of triangulation carried on throughout the state. City and private engineers will find the publication useful in the establishment of precise control that accords with a government standard.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN CITY GOVERNMENT—By William Anderson, Ph.D., Professor of Political Science, and Director of the Bureau for Research in Government, University of Minnesota. [American Political Science Series, Under the Editorship of Edward S. Corwin, Princeton University] New York: Henry Holt & Co. Cloth; 6x9 in.; pp. 675. $5.

AN ARCHITECT'S SIMPLE ENGINEERING PROBLEMS—By DeWitt Clinton Pond. New York: Charles Scribner's Sons. Cloth; 5x8 in.; pp. 90; 23 line cuts. Special net, $1.50.

A clear exposition of the elementary problems in structural designs.

ARCHITECTURAL IRON DESIGN AND DETAILING (As Required by the Laws of New York)—By Daniel M. Driscoll, Instructor in Ornamental Iron Detailing, Mechanics Institute, New York City; With on Introduction by Louis Rouillon, B.S., M.A., Director, Mechanics Institute, New York City. New York: D. Van Nostrand Co. Cloth; 11x8 in.; pp. 349; 210 plates; Appendix, with tables, drawings, and text of the Building Code for the City of New York. $4.

Textbook and reference for students of and workers in ornamental iron. Primarily arranged for use by classes of the Mechanics Institute of New York. All designs and details conform with the building code requirements. Presents most modern practice in uses of iron for stairs, bank grills, elevator enclosures, etc. Among few books of its kind.

THE CASE FOR CAPITALISM—By Hartley Withers, Author of "The Meaning of Money," "Stocks and Shares," etc. London, England: Eveleigh Nash and Grayson, Ltd. Cloth; 5x8 in.; pp. 277.

Third printing of a book first published in 1920. Defends capitalism while admitting some of its weaknesses. Examines the demands of labor and the claims of both state and guild socialism, and flays the latter harder than the former. Takes up proposed capital levy. At close urges changed attitude of capital toward wage earners, and the larger use of "great profits when earned" for "worthy public objects" and for the further development of industry on the one hand and on the other that employees invest their savings in industrial enterprises rather than Government securities.

ÉCLAIRAGE ELECTRIQUE—Par P. Maurer, Ingénieur a la Compagnie Parisienne de Distribution d'Électricité, Professeur a l'École d'Électricité Breguet et a l'École d'Électricité et de Mécanique Industrielles. [École d'Électricité et de Mécanique Industrielles.] Paris: Gauthier-Villars et Cie., Editeurs; Libraires du Bureau des Longitudes, de l'École Polytechnique, 55 Quai des Grands-Augustins. Paper; 6x9 in.; pp. 143; 71 line cuts.

ELEMENTARY ELECTRICAL TECHNOLOGY FOR ENGINEERING STUDENTS—By A. M. Parkinson, B.Sc.Eng. (Lon.), A.M.I.E.E., Lecturer in Electrical Engineering at the Battersea Polytechnic. New York: Oxford University Press, American Branch. Cloth; 5x7 in.; pp. 179; 129 line cuts. $2. 6s. net in London.

AN INVESTIGATION OF THE FATIGUE OF METALS, SERIES OF 1925: A Report of the Investigation, Conducted by the Engineering Experiment Station, University of Illinois; In Cooperation with the National Research Council, Engineering Foundation, General Electric Co., Allis-Chalmers Manufacturing Co., Copper and Brass Research Association, and Western Electric Co.—By H. F. Moore, Research Professor of Engineering Materials, in Charge, Investigation of the Fatigue of Metals; and T. M. Jasper, Research Associate Professor of Engineering Materials, Engineer of Tests, Investigation of the Fatigue of Metals. [Bulletin 152.] Urbana, Ill.: Engineering Experiment Station, University of Illinois. Paper; 6x9 in.; pp. 89; 29 line cuts and halftones, 20 tables. Limited number available for free distribution; otherwise 50c.

MARKETING—By Edmund Brown, Jr., Ph. D., Member Consulting Board, Brookmire Economic Service, Inc., Formerly Associate Professor of Marketing, University of North Carolina. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 503; 6 halftones; statistical tables. $3.

PRACTICAL BUILDING CONSTRUCTION: A handbook for Students Preparing for the Examinations of the Science and Art Department, the Royal Institute of British Architects, the Surveyors' Institution, etc., Designed also as a Book of Reference for Persons Engaged in Building—By John Parnell Allen, Fellow of the Surveyors' Institution, Formerly lecturer on Building Construction at the Armstrong College of Science, Newcastle-on-Tyne. Sixth Edition, Revised. New York: D. Van Nostrand Co.; London: Crosby Lockwood and Son. Cloth; 6x9 in.; pp. 584; 1,300 line cuts. $6.

Chiefly architectural details, but some engineering details also, all showing British practice; 13 pp. on stresses, 46 on calculations of strains in cantilevers, trusses and girders, and 34 on ventilation, plumbing, sewage disposal for isolated buildings, heating and electric lighting. Evidently great pains have been taken to illustrate proprietary materials.

RAILROAD CONSTRUCTION—THEORY AND PRACTICE: A Text-Book for the Use of Students in Colleges and Technical Schools, and a Hand-Book for the Use of Engineers in Field and Office—By Walter Loring Webb, C.E., M.Am.Soc.C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railroad Engineering) in the University of Pennsylvania, 1895-1901, Major, Engineer Corps, U. S. A., 1917-1920, etc. [Eighth Edition, Revised.] New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Flexible; 5x7 in.; pp. 849; 225 line cuts and halftones, appendix with mathematical tables. $5.

New and more exact methods of computing the possibilities of locomotives have been developed. To make these methods more generally available the chapter on The Power of the Locomotive has been entirely rewritten and the one on Grades has been partly rewritten and added to. Some minor changes have been made in other chapters to bring the book up to date.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Leakage Test for 36-In. Concrete Sewage Force Main, Dallas, Texas

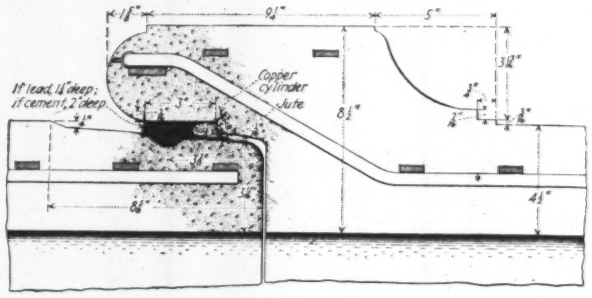
Sir—In your issue of Nov. 26, 1925, p. 870, there was an interesting article on "Leakage Tests of Cast-Iron Force Main at Columbus, Ohio," by John C. Prior. That article prompts me to send you the contract test results for leakage in a sewage force main just completed by the city of Dallas for which, instead of cast-iron, reinforced-concrete pipe was used. The line is 36 in. in diameter and has a total length of 14,250 ft. It is composed of precast pipe, in 12-ft. lengths, or 440 lengths per mile, and except for two or three joints in wet places the jointing material throughout was of neat cement, about the consistency of putty, calked against jute. The thickness of the walls is 4½ in. The concrete was of 1:1½:2 mix with 5 per cent of lime, with crushed limestone aggregate passing a ¾-in. screen. The pipe is patented and is known as the "Trammell system copper bell concrete pressure pipe." It is the result of ten years of development work by J. D. Trammell, a civil and hydraulic engineer of Fort Worth, Tex. Mr. Trammell was the contractor for making and laying the pipe.

A 14-day contract test showed a leakage for the entire pipe line averaging 117 gal. per inch diameter of pipe per mile in 24 hr. compared with the contract requirement of 200 gal. Before letting the contract for the duplicate force main bids were received for both cast-iron and reinforced-concrete pipe, $213,333 and $173,788, or concrete $39,545 less.

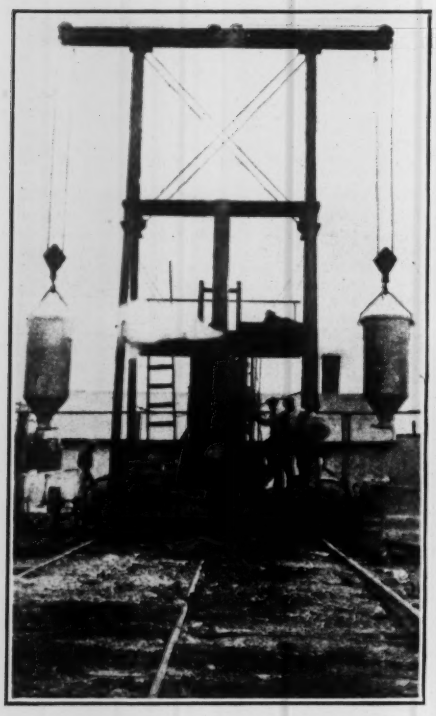
The new force main parallels a lock-joint reinforced-concrete pipe of the same diameter, which was laid in 1915 and has given satisfactory service as a force main—the capacity of which has been reached. The soil in which the pipe is laid is largely a sedimentary deposit, the only rock encountered being underneath Cedar Creek. The difference in level between the pumps and the outlet end of the force main is about 34.5 ft. Due to the nature of the soil encountered and the lack of water service lines in the vicinity of the force main, it was impossible to test the pipe section by section to full hydrostatic head. With the consent of the contractor, a single test of the entire line was made after completion, extending over a period of 14 days, as already stated—this final test being made after a preliminary one to make sure there were no weak points or serious leaks. A few bad joints were found and rectified.

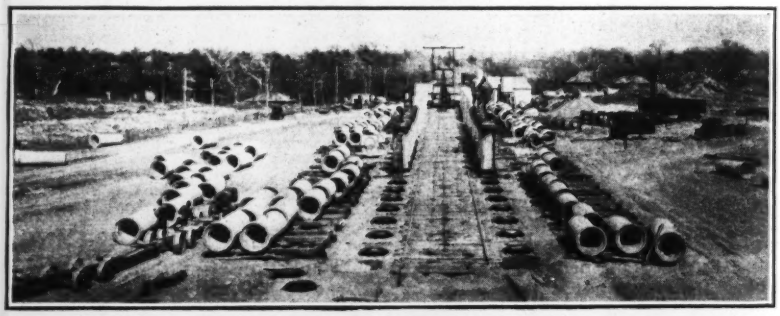
To test the mortar joints before starting the pipe laying, two lengths of pipe were selected at random from stock in hand, jointed with a cement mortar designed to be used on the work, both the mix and the method of jointing being as nearly as possible like that to be expected on the construction job. The ends of the pipe were headed up and pressure was applied under the supervision of the inspector on the job. No appreciable leak appeared up to 200-lb. pressure, either through the joint or the pipe itself. Experience seemed to indicate that it was unnecessary to use the lead joint in the wet places.

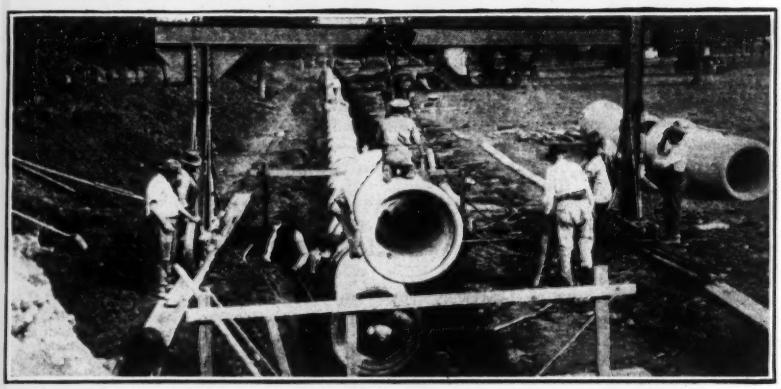
E. A. KINGSLEY,
Dallas, Tex., Jan. 6, 1926. City Engineer.



JOINT DETAIL FOR TRAMMELL PRESSURE PIPE







PRECASTING AND LAYING TRAMMELL SYSTEM CONCRETE PRESSURE PIPE FOR DALLAS, TEXAS

At Left—Traveling crane, showing pouring buckets; crane with buckets is moving off, ready to pour a section of pipe. Top Right—General view of precasting plant. Completed pipe, curing, lies along track. In foreground, paralleling track are seven bases for forms each side of track. Following these are several newly made sections with forms still in place and farther back a number of sections with forms have been stripped. Bottom Right—Laying pipe. Note the perfect alignment in the trench. Spigots fitted bells perfectly.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Ohio Engineers' Convention Held in Columbus

Highway Construction Discussed, Favor More Publicity and Law to License Engineers

Of the eight papers presented at the Ohio Engineering Society Feb. 4 and 5, three referred to highways, two were professional and one each on sanitary engineering, concrete and a stadium. The society called on its members to pay more attention to publicity, favored enactment of an engineers' license law, federal aid, restoration of the ½ mill state tax for roads and deplored the growing controversy between the Bureau of Public Roads and the State Highway Department. For several years no proceedings have been published but the secretary and publication committee were asked to work out and effect some means of doing so this year.

Of the highway papers Prof. F. H. Eno described progress on subsoil investigations being carried on jointly by the Bureau of Public Roads and the State Highway Department. The chief purpose is to determine moisture factors of soils all over the state affecting road designs. Prof. Eno has a year's leave of absence from Ohio State University to care for the investigation. Besides soil analysis observations are being made of pavement behavior. Highway bridge improvements were noted in a paper by J. R. Burkey, chief bridge engineer, State Highway Department. Better expansion joints and smooth guard rails of channels rather than the old latticed work of horse-and-buggy days were suggested. In general, he felt that road design had outstripped that of highway bridges.

Salvaging Pavements

Salvaging old pavements will become more and more one of the highway engineer's most serious problems said A. H. Hinkle, chief maintenance engineer of Indiana, in a meaty paper on the subject. He gave precautions as to all of the present methods and stated that one of the hardest decisions of the engineer was to choose between resurfacing, which maintained all the faults of grade, location and crown and new pavement at higher cost. An out-of-date or unsafe road though it may have a smooth surface is undesirable. Six experimental resurfacing methods, being used on 500 ft. stretches of the Lincoln Highway in St. Joseph County, include sheet asphalt, asphaltic concrete, natural rock asphalt, and a thin 5-in. reinforced-concrete slab. Mr. Hinkle's theory is that three-quarters of all country road failures are due to failure of the road crust.

George B. Gascoigne's paper on "Progress in Sanitary Engineering," concluded that sanitary problems need no longer be solved in a haphazard manner for the methods are now known by which to handle most any problem. It follows, he said, that the public health engineer (new name for sanitary engineer adopted by the American Public Health Association) must be well informed. In discussion, E. G. Bradbury said that $150,000,000 to $200,000,000 would be spent on sanitary engineering works in Ohio in the next 10 years judging from the 1925 outlay. He touched on a joker in the state law restricting the county sanitary engineer's salary to that of the county auditor. County work is spreading fast in Ohio and the counties are by-passing the law by employing a figure head as engineer and getting the engineering work done on a percentage basis in which irregularity has crept in to the taxpayer's detriment.

R. N. Waid, head of the society's legislative committee told a heart-breaking story of getting the governor and both houses of the legislature sold on an engineer's registration law and then having it withheld in committee through the influence of two legislators, who are engineers, on the committee.

The newly elected officers are as follows: President, W. C. Fawcett; vice-presidents, Atlee M. Wise and Curtis C. Lattimer; secretary-treasurer, C. L. Van Voorhis.

Engineering Fifty Years Ago

From *Engineering News*, February, 1876

THE new narrow gage R.R. from Boston to Haverhill will be thirty miles long and as nearly an air-line as possible, making the distance six miles shorter than by the present Boston and Maine route. There will be branches to Lawrence, Andover, Groveland, and also to Revere Beach where it connects with the Lynn narrow gage.

Paris to Hold Competition for Traffic Relief Plans

The city of Paris announces a prize competition for plans designed to relieve traffic congestion by the construction of subways and underground garages. The competition is open to everyone, but applications to compete must be filed before March 31. All plans must be in by June 30. A sum of 100,000 francs has been set aside for use by the award jury. Anyone interested can secure more complete information by addressing la Direction des Travaux de Paris (Secrétariat) 98, quai de la Rapée, Paris, France.

Canadian Engineers Hold Annual Meeting

Toronto Chapter Receives Charter, New Officers Elected for Coming Year

The Engineering Institute of Canada convened for its 40th annual meeting at Montreal on Jan. 26 and adjourned to Toronto, Ont., for the technical sessions and social functions which were held Jan. 27-29. About 414 members, representing all branches of the Institute, registered at the meeting, and a large number of undergraduate students from the faculty of engineering of the University of Toronto attended the technical sessions. An interesting feature of the session of Jan. 27 was the presentation by Arthur Surveyer, the retiring president, to the Toronto branch, its charter from the Engineering Institute of Canada. The original charter of the Toronto branch was granted by the predecessor of the Engineering Institute of Canada, the Canadian Society of Civil Engineers, in the year 1889.

Civil Engineering Papers

At the civil engineering sessions the following papers were presented: Deterioration of Concrete in Alkali Soils, Prof. C. J. Mackenzie, and Prof. T. Thorvaldson, Univ. of Saskatchewan; Design of East York Sewers and their Construction by Contract and Day Labor, R. O. Wynne-Roberts, consulting engineer, Toronto, and Grant R. Jack, township engineer; The Water Supply of the Border Cities, Wm. Gore, consulting engineer, Toronto, and J. B. Clark Keith, chief engineer, Essex Border Utilities Commission; Reduction of Flexural Stresses in Fixed Concrete Arches, J. F. Brett, designing engineer, Montreal Water Board.

The Mechanical and Electrical section considered the following papers: Steam Power Plant Design, Prof. A. G. Christie, Johns Hopkins University; Generation of Explosive Gases in Electric Water Heaters and Boilers Operating on Alternating Current with Submerged Electrodes, Prof. J. W. Shipley, University of Manitoba and A. Blackie, National Testing Laboratories, Ltd., Winnipeg; European Transmission Practice, A. E. Davison, transmission engineer, Hydro-Electric Power Commission of Ontario.

At the general professional meetings papers were read and discussed upon: The Influence of the Modern Highway, W. A. McLean, consulting engineer, Toronto; Some Phases of Industrial Relations, Homer E. Niesz, Manager, Industrial Relations Department, Commonwealth Edison Co., Chicago.

The new officers of the Institute are: President, G. A. Walkem; vice-pres. A. S. Dawson, Peter Gillespie, K. B. Thornton, W. G. Mitchell, and G. D. MacDougall.

Two Western Chapters of A.A.E. Declare Independence

Two chapters of the American Association of Engineers on the Pacific Coast recently declared their withdrawal from the Association and at the same time reconstituted themselves as independent organizations. On Nov. 25 the Oregon Chapter became an independent organization under the name Northwestern Association of Engineers, which will take over the employment service hitherto conducted by the Oregon Chapter, will remain in the former quarters of the chapter, and employ the chapter's former secretary, according to an announcement in *The Northwestern Engineer* of December, the publication of the new organization. It is stated that the officers of the former chapter "became convinced that there is very little future for A.A.E. in the Northwest, but that need for a regional association devoted to the social and economic needs of engineers does exist." By resolution at a subsequent meeting of the executive committee of the Oregon Chapter, A.A.E., the chapter organization will be maintained in existence, and the invitation of the Northwestern Association of Engineers to the chapter to transact business at its office, rent free, for the coming fiscal year will be accepted. Later information indicates that the members of the old chapter are reorganizing as the Portland Chapter.

The San Francisco Chapter of the American Association of Engineers on Dec. 15 withdrew from the central organization and took the name Society of Engineers.

Statements of Western men concerned in the secession movement reflect resentment at what they call the present policy of the national organization of the A.A.E. to make the national organization strong and the chapters weak. They object, in particular, to the decision of the National Board of Directors to make membership in chapters optional, and to establish separate national and local dues. The Western claim is that these actions tend toward the disintegration of strong chapters.

Last spring the Michigan state organization was dissolved as an A.A.E. affiliate and since then several of the smaller chapters like Lansing have disbanded but the Detroit Chapter, the largest unit, still flourishes. The Indianapolis Chapter went out of business last fall. Against these defections is the encouraging report of headquarters that about 400 restorations of members are being received per week. Despite the establishment of the former 90-day arrearage limit it is believed by headquarters that a count of bona fide members now under way will reach 7,000. New members are coming in at about the normal rate.

Cloudburst Flood in Kentucky

A flood of unprecedented proportions in the valley occupied by the hamlet of Coaldale, Ky., on Feb. 14, destroyed the hamlet and caused the death of 7 persons. The rains which caused the flood appear to have been part of a general heavy storm covering all of Pike County.

Large Sums for Improvements Approved at Detroit

An issue of public improvement bonds amounting to $13,410,000 was approved recently by the Detroit city council to cover a comprehensive plan of civic improvements. Among the principal items are $3,950,000 for public sewers in newly annexed territory, $3,500,000 for improvements to the municipal street railway system, $3,000,000 for additional water facilities, $2,485,000 for new schools and $475,000 for grade separation projects. In some cases the money derived from the sale of the bonds will be used to retire short term notes issued where contracts are already under way.

Over $6,500,000 to Be Spent for New Hetch Hetchy Work

The San Francisco board of supervisors on Feb. 8 approved the expenditure of $6,525,000 on the Foothill division of the Hetch Hetchy project. These funds are for the construction of the regulating reservoir at Moccasin power house, the driving of approximately 17 miles of tunnel in the Foothill division which will be of a capacity sufficient to handle 400 m.g.d., and the completion of connections to the Red Mountain Bar siphon.

New City Engineer for North Adams

Harrison L. Ashley has been appointed city engineer of North Adams, Mass., by Commissioner of Public Works Eolus Doble, to fill the position left vacant by the removal of Charles E. Wells as reported in *Engineering News-Record* Aug. 27, 1925, p. 359, and Oct. 22, p. 690. Mr. Ashley has been assistant city engineer for four years.

Decision in Niles Cone Case in Favor of Spring Valley Co.

The Spring Valley Water Co. of San Francisco may increase its diversions from Alameda Creek, according to a decision recently handed down by Judge H. D. Burroughs in the Alameda County Superior Court, deciding in the company's favor the Niles Cone water case which has been in controversy since 1913.

The suit was brought by Patterson Bros., owners of land on the Alameda Creek delta, known as Niles Cones, in an endeavor to obtain an injunction preventing the company from increasing its diversions of 21 m.g.d. This court action followed a ruling by the State Water Commission made after field investigations in connection with the case had extended over three years. The Water Commission ruling granted the water company the right to store and divert additional water provided there was released from storage annually that part of the impounded water which would have escaped from Alameda Creek by percolation into the gravels underlying lands not owned by Spring Valley Co. The Superior Court, in Judge Burroughs decision, has now confirmed the findings of the Water Commission.

Sanitary District of Chicago Passes Largest Budget

An increase of $5,432,310 over 1925 is noted in the annual budget of the Sanitary District of Chicago passed Jan. 2, 1926. This brings the total to $42,253,953, an increase for the engineering department of $2,715,302 to $30,107,492, while $7,200,000 is for bond retirements and interest as compared with $4,700,000 in last year's budget. Last year about $14,000,000 was actually expended but it is probable that about $20,000,000 will be paid out this year. About $11,500,000 will be for contracts started previously to Jan. 1, 1925.

The principal items in the 1926 budget are for sewage disposal in accordance with the program laid down by the Secretary of War when the 5-year, 8,500-sec.-ft. diversion permit was issued.

First, for the $13,500,000 North Side Plant, which will care for 800,000 people and is 44 per cent completed, $7,621,000 was appropriated. Work is to start this year on the West Side Plant which will care for the central business district and area west having an estimated population in 1940 of 1,850,000. For the start on this plant $3,000,000 was set aside and $3,000,000 for the intercepters leading to it. Eventually, the West Side Plant will cost $13,300,000. Land for the West Side and South West Side Plants is to be purchased and $1,500,000 is set aside.

Funds ($2,008,000) are provided to complete bridges over the Main Channel at California, Crawford and Cicero Aves., also for spans at Roosevelt Road and Western Ave., and the McCormick Road subway.

An item of $100,000 is included for the controlling works in the Chicago River, and $200,000 for additions to the Des Plaines River Treatment Works. For personnel in the engineering department, nearly $2,500,000 is made available.

"The program is laid down in 5-year periods" according to a statement issued concurrently with the budget by E. J. Kelly, chief engineer. "To meet the terms imposed, definite and combined action is required on our part looking forward to the ultimate completion of a system of intercepting sewers, pumping stations and treatment works, whereby all the suspended solids will be retained and the liquid pollution so reduced biologically that the main channel and Illinois River will be cleaned up."

Contractors Oppose Day-Labor for Public Improvement

An organization known as the Public Works Contractors' Association has been formed at Tacoma, Wash. The principal aim of this association is to oppose the day-labor method of handling construction, especially public improvements.

It consists of about 30 local contractors headed by D. I. Cornell, A. B. Comfort and Capt. W. B. Nelson. Application will be made to the Associated General Contractors of America for a charter.

WASHINGTON NOTES

AN ADDITIONAL $350,000 has been asked by the Indian Service for its Flathead reservation irrigation and power project. The sum of $575,000 already has been voted for the next fiscal year. Not more than $380,000 is to be expended on the power plant.

THE forthcoming report of the Board on the Lakes-to-Hudson deeper waterway, of which Colonel Herbert Deakyne is chairman, is being awaited with much interest. The application of present costs to the report of the board which reported in 1900, is expected to show that the costs of the project will be at least double if carried out at this time.

This would mean that the proposed ship canal following the Oswego-Mohawk route from the Great Lakes to tidewater would call for an expenditure of some half billion of dollars.

An idea of cost increases may be had from these unit costs taken from the 1900 report: earth excavation, 8 to 20 cents per cu.yd.; dry rock excavation, 65 to 70 cents per cu.yd.; submerged rock, $2.00 per cu.yd.; masonry construction, $4.00 to $6.00 per cu.yd.

NEGOTIATIONS looking to the checking of the erosion of the crest of Niagara Falls are in progress between the governments of Canada and the United States. Since the question of diverting more water for power purposes would give rise to controversy, it is believed that the United States hopes the question of recession at the falls can be considered without reference to power questions.

The need for taking action at the earliest possible moment to protect the falls is recognized in the Dominion as it is here. The need for more power is probably greater on the American side, but Canada does not have to reckon with numerous organizations that will see in any further diversion at Niagara Falls a step likely to mar their scenic beauty. The consensus of engineering opinion is that one of the best ways to enhance the scenic beauty of the falls and to reduce recession is to distribute the water passing over the crest and reduce its volume.

According to the Canadian press the authorities there believe the questions involved should be taken up for preliminary discussion by representatives of the two governments to be appointed for the purpose. Apparently the thought is that were General Edgar Jadwin and some Canadian engineers of equal eminence, for instance, named by their respective governments they could submit early recommendations for the most practical way to proceed.

THE Federal Power Commission and its individual members will support the proposed amendment to the water power act which will permit the Commission to employ its own personnel to the extent that funds are made available to the administrative portion of the license fees.

Commission is Optimistic Over Future of Barge Canal

Unqualified endorsement of the Barge Canal as a vital agency of transportation is contained in the report of the Barge Canal Survey Commission, which has just made its report to the New York State Legislature.

"From testimony given by traffic men," says the report, "it would appear that during 1925 the Barge Canal saved the people of this state approximately $52,000,000. Of this $2,000,000 is estimated as being the direct saving on tonnage floated at the lesser water rates; the $50,000,000 is accredited to freight carried by rail which, due to canal competition, is apparently handled in New York State at lower rates than in states which lack water competition."

Some of the recommendations of the Commission are:

That all necessary provisions be made at once to assure at least a 12 ft. channel at all times; that the approach walls to locks in canalized rivers be lengthened; that a supply of sectional wooden lock gates for emergency use be provided; that the state purchase and own sufficient equipment for dredging, repair, maintenance and operation of the canal as far as practicable; that the banks be rip-rapped to prevent erosion. This erosion not only lessens the depth of the channel but subjects the state to constant claims for damage done to property; that all water power made possible by the construction of the canal and its future improvements be developed and utilized; that the old Erie Canal between Watertown and the southern boundary of Cohoes be abandoned.

Fin Type Surface Air Cooler for Hydro-Electric Generator

The new plant of the Louisville Hydro-Electric Co. on the Ohio River is to have generators equipped with fin type surface air coolers. This is the first use of this type of cooling system for hydro-electric equipment which has its major application on turbo-generators.

Because of the use of soft coal in the city nearby, the air is unsuited for open ventilation of generators. It has therefore been decided to use the closed system of ventilation.

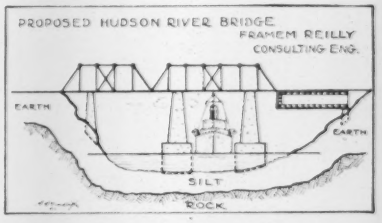
Detroit Contracts for 83 Miles of Centrifugal Cast Pipe

The Water Department of Detroit, Mich., has awarded contracts for 198,200 ft. of 6-in. and 240,000 ft. of 8-in. centrifugal cast-iron pipe, or about 84 miles in all, to the United States Cast Iron Pipe & Foundry Co. at 72c. and $1.02 per foot, f.o.b., Detroit. Contracts have also been let for 8,000 tons of 12- and 16-in. Standard Class C cast-iron pipe, of which 2,000 tons of 12-in. will be supplied by the Lynchburg Foundry Co. at $45.30 a ton, and another 2,000 of 12-in. and 4,000 tons of 16-in. by B. Nicol & Co., New York City, at $45.32 and $45.12 a ton. The city wishes to interest outside contractors in bidding on pipe laying jobs to be done the coming season.

RANDOM LINES

A Determinate Structure

Those members of the American Society of Civil Engineers who witnessed the skit the New York section



put on at the annual smoker this year will want to preserve this drawing of one of Framem Reilly's masterpieces.

* * *

More Bridges

And while we are about it we might as well add two more equally illustrious examples of the bridge builder's art.

(A) From an advertisement by Gillet & Co., bankers, of Baltimore.

(B) A calendar by the Jewett Lumber Co. of Des Moines.

* * *

Superfluous!

A subscriber in China sends us this clipping from the advertising pages of this journal. The italics are his:

RECENT graduate, civil engineer, with *knowledge of plan reading*, wanted immediately to work in estimating department of contractor's office.

Court Decision on Plate Steel Scroll Cases

A recent decision of interest to hydraulic engineers has been handed down by Judge Sibley in the U. S. District Court for the Northern District of Georgia, dealing with the plate steel scroll cases.

The Allis-Chalmers Co. as exclusive licensees of the W. M. White patent on sheet steel spiral casings, brought suit for infringement against the Columbus Electric and Power Co. naming several installations, among which were the Goat Rock and Bartletts Ferry Developments. Defense was assumed by the S. Morgan Smith Co., manufacturers of these particular scroll cases.

Decree was entered in favor of the defendant, the defences being principally; "invalidity of the patent for want of invention and novelty, and non-infringement."

Judge Sibley pointed out that "to bend the penstock around the turbine, as had before been done around obstructions, reducing its section as that of the spiral was reduced, seems to be only ordinary skill in designing. . . . I am clear that if there be invention it lies not in the use of the spiral form of casing, nor the use of the speed rings uniting circular sections, nor in the use of sheet metal as a material, but in the use of flat steel deformed only by ordinary bending, the discovery being that the resulting distortion of the spiral was not material or was easily compensated for.

"I think the expression 'having straight line generatrices in the direction of the flow in the casing' means that the sections are made from flat sheets by bending them and without other substantial deformation. This I take to be the patentable novelty recognized by the patent office in this spiral casing, the simplicity and cheapness of the construction being its utility."

He continues, "the castings made and used by the defendant do not infringe the patent. Every one, I conceive has the right to make a spiral casing in a form like to the cast iron ones, by substituting sheet steel formed and joined by ordinary sheet metal working methods."

Agreement Signed to Build Harahan Bridge Approaches

Highway authorities of Tennessee and Arkansas on Feb. 6 signed an agreement to build highway approaches to the Harahan bridge over the Mississippi River, at a cost of something over $1,000,000. Memphis will pay $369,000, Tennessee and Arkansas respectively $213,000 and $291,000, and the Viaduct Improvement District $220,000.

American Health Congress Called at Atlantic City in May

An American Health Congress is to be held at Atlantic City, N. J., during the week beginning May 17, 1926, under the auspices of the National Health Council, 370 Seventh Ave., New York City, which is made up of various health organizations in the United States.

Asphalt Technologists Form New Association

The Association of Asphalt Paving Technologists was organized in Chicago Jan. 14, with 40 members. The association will collect and distribute technical data pertaining to asphalt paving, encourage and conduct co-operative research work, and will serve as a clearing house of ideas.

The officers for the present year are: President, Hugh W. Skidmore, president Chicago Paving Laboratory, Inc., Chicago; first vice-president, Leroy M. Law, chief chemist, New Orleans Refining Co., New Orleans; second vice-president, W. J. Emmons, highway research specialist, U. S. Bureau of Public Roads, Washington, D. C.; secretary-treasurer, Charles A. Mullen, director, paving department, Milton Hersey Co., Montreal; chairman general research committee, Prevost Hubbard, chemical engineer, Asphalt Association, New York, N. Y.; chairman, committee on voids in aggregates, W. J. Emmons, U. S. Bureau of Public Roads; chairman, committee on street operations, W. L. Hempelmann, engineer, Texas Co., Asphalt Department, Chicago.

Agreement Reached on Terminal Plans at St. Louis

Terms have been agreed upon between a citizens committee and officials of the principal trunk line railroads entering St. Louis which, if ratified by the city administration and the citizens at a special election, will result in the abandonment of the railway deck of the Eads bridge by the railways in order that it may be used for highway purposes and the diversion of railway traffic to the municipal bridge. The plan calls for the construction of railroad approaches to the municipal bridge on the east side of the Mississippi River and a radical rearrangement of the yards on that side to eliminate a number of grade crossings.

The plan provides for a new union station in East St. Louis and the extension of facilities at the Union Station, St. Louis. The cost of the entire change is placed at $100,000,000 and of the first step, including the exchange of bridges, at from $15,000,000 to $20,000,000.

Proposed Columbia River Bridge Disapproved by Commission

The Port of Portland Commission has rejected the plans submitted by promoters of the proposed Rainier-Longview bridge over the Columbia River, noted in *Engineering News-Record*, Feb. 11, p. 257.

Reasons given for the rejection were that the clearances provided were not sufficient and would obstruct the channel. Those of the Quebec bridge crossing the St. Lawrence were taken as a criterion and it was suggested that plans for a Columbia River bridge to receive the approval of this body should provide for a clearance of 175 ft. above low water, a width of not less than 600 ft. at the top of the channel span, and not less than 750 ft. between the faces of the channel piers.

Texas School for Water Plant Men Held at Fort Worth

The Eighth Texas Water-Works Short School held at Fort Worth Jan. 18-25, 1926, closed with a registration of 250 and was declared to be the most successful of these meetings which are held by the Texas Section of the Southwest Water-Works Association in co-operation with Texas Christian University, the Fort Worth Water and Health Departments, and the Texas State Board of Health. W. S. Mahlie, chief chemist at the Fort Worth water filtration plant, served as director.

The sessions of the school this year were placed under four divisions: Laboratory and Lectures, Plant Operation, General Sanitation, and Convention.

Among the papers presented were the following: Aeration of Water, by C. A. Emerson, Jr., representing George W. Fuller of New York City; Mixing Devices and Water Softening, by Chas. P. Hoover, Columbus, Ohio; Coagulation and Sedimentation and Dosing Appliances, by L. I. Birdsall, Chicago; Effective Chlorination with Minimum Production of Tastes and Odors, by L. H. Enslow of the Chlorine Institute, New York City; Tests for Sewage Disposal Plant Control, by Col. Edward Bartow of the State University of Iowa, and Frank Bachmann, representing the Dorr Co., Chicago; Sewage Disposal by Paul Hansen of Pearse, Greeley & Hansen, Chicago; Bacteriology of Water, by Jack Hinman of the Iowa State Board of Health.

A. L. Dopmeyer of the U. S. Public Health Service and Ernest Boyce, State Sanitary Engineer of Kansas were also among the out-of-state speakers who contributed papers, in addition to Texas engineers and water-works officials.

The following officers were elected: President, W. S. Mahlie, Fort Worth; secretary, V. M. Ehlers, Austin.

Missouri Drainage Law Declared to Be Constitutional

In a decision rendered Feb. 1 the United States Supreme Court sustained the constitutionality of the Missouri drainage law of 1913. This law permits creation of drainage districts by majority vote of the owners of property to be included in the district. The Norborne Land Drainage District of Carroll county was created under this law. Originally it included 14,400 acres. Later, 24,000 acres were added, and some of the property owners in the added territory objected on the ground they had not been given a voice and that the assessments against their property were excessive in proportion to the benefits to be derived. Chas. D. Cole and others filed suit as a protest. They lost in the state courts, and then sued in the federal courts, alleging violation of the Fourteenth Amendment. They lost in the lower court and this decision is affirmed by the Supreme Court, which held that their rights were fully protected under the state law and that the state courts had found no injustice had been done them.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

The American Ceramics Society held its annual meeting Feb. 8 to 11 in Atlanta, Ga.; seven industrial divisions held sessions, two of them being the Heavy Clay Products Division and the Terra Cotta Division.

The Canadian Section of the American Water Works Association will hold a meeting at St. Catharines, Ont., March 3 to 5; A. U. Sanderson, superintendent of the Toronto filtration plant, is president of this section.

The Ontario Good Roads Association will hold its annual meeting in Toronto Feb. 24 to 26; the secretary is T. J. Mahony, 110 University Ave., Toronto, Ont. The **Ontario Road Superintendents' Conference** will have its annual meeting in Toronto Feb. 22 to 26 to coincide with the association meeting; the secretary is R. C. Muir, 110 University Ave., Toronto, Ont.

The Charleston, W. Va., Chapter of the American Association of Engineers installed its president for this year, J. Walter Morgan, at a dinner Jan. 10 attended by engineers from other West Virginia cities and by former governor E. F. Morgan.

The Phoenix (Ariz.) Chapter of the American Association of Engineers has elected officers as follows: president, James B. Girand; vice-presidents, James Brown, W. S. Johnson, and Ralph Hoffman. The retiring president is Henry Rieger, city manager of Phoenix.

Western Washington Section, American Society of Civil Engineers, Seattle, Wash., recently elected Col. W. J. Barden, division engineer, U. S. Engineer Corps, president. T. R. Beeman, King County engineer, was named vice-president; E. L. Strandberg, secretary-treasurer, was re-elected.

American Water Works Association nominating committee has selected the following members for the various offices to be filled at the Buffalo convention, for 1926-1927: for president, Allan W. Cuddeback, engineer and vice-president, Passaic Water Co., Paterson, N. J.; vice-president, James E. Gibson, manager, Water Department, Charleston, S. C.; treasurer, William W. Brush, deputy chief engineer, Bureau of Water, New York, N. Y.

The Engineers' Society of Western Pennsylvania, at its annual meeting elected V. R. Covell chairman, and R. P. Forsberg vice-chairman.

Personal Notes

CHARLES H. WINDHAM, city manager and former mayor of Long Beach, Calif., has resigned to accept a position in harbor construction work.

H. D. HURLEY, formerly with the Massachusetts Division of Highways, is now assistant engineer with the department of city transit of Boston.

NORMAN G. YOUNG, Hollidaysburg, Pa., has been elected borough engineer of Roaring Spring, Pa., succeeding J. Luden Henry.

A. W. BOWIE, engineer and constructor, and CHARLES S. CLARK, owner of the Clark Construction Co., both of Binghamton, N. Y., have consolidated all of their interests and will operate an engineering and construction service as Bowie-Clark, Inc., with offices in the Press Building, at Binghamton.

HARVEY ROBINSON, of Mercer, Pa., has been appointed district highway engineer for Mercer, Butler, Venango and Lawrence Counties, Pennsylvania, succeeding J. C. MCCARRELL who has been transferred to Harrisburgh.

LEON P. ALFORD, Montclair, N. J., vice-president of the Management Engineering Corporation, has been elected to the board of trustees of the National Museum of Engineering and Industry as a representative of the American Society of Mechanical Engineers. Mr. Alford is a graduate of Worcester Polytechnic Institute.

MATTHEW S. MURRAY, engineer in charge of surveys and plans, Missouri Highway Commission, Jefferson City, has been chosen as director of public works of Kansas City, Mo., by H. F. McElroy, city manager designate under the new commissioner manager charter that goes into effect on April 10. Mr. Matthews, by virtue of his office, will also be chairman of the Traffic Ways Commission. Before holding the position he is about to leave Mr. Matthews was division engineer in charge of the Southeast Missouri District of the State Highway Commission and before that he was engaged in contracting. He was born at Dayton, Ohio, 42 years ago.

E. CLARK COWDEN has been appointed city engineer in Harrisburg, Pa., in succession to his father, M. B. Cowden, who died recently, and it is notable that his grandfather also held the office. E. Clark Cowden has for years been identified with municipal developments in Harrisburg both as an engineer in private practice and as engineer of the city planning commission. In addition, he recently completed his work as chairman of the engineers' conference which studied the major grade crossing and subway improvements for the Pinchot commission.

BRUCE ELLIS, former member of the common council of Los Angeles, Calif., has been appointed city engineer of Tucson, Ariz.

C. H. FIRSTBROOK, who has practiced in general engineering and surveying at Plainfield, N. J., has been appointed borough engineer of North Plainfield, N. J.; he will continue his private practice with offices in the Babcock Building, Plainfield.

Obituary

HARVEY T. WARD, Tecumseh, Neb., for forty years a bridge contractor in Nebraska, died Feb. 5 at the age of 74 years.

J. M. RUTHRAUFF, Phoenix, Ariz., former city and county engineer, died suddenly Jan. 27 of a heart attack.

BENJAMIN F. POWELL, superintendent of the Fort Lyons Canal Co., an irrigation engineer in the Arkansas valley for a half a century, died at his home at Las Animas, Colo., Feb. 2. Mr. Powell had been in ill-health for the past six months.

WIBLE L. MAPOTHER, president of the Louisville & Nashville R.R., died suddenly of heart disease Feb. 3 at a hotel in Panama, where he had gone for a vacation. Mr. Mapother was born in Louisville, Ky., in 1872. In the spring of 1890 he entered the employ of the Louisville & N shville as an office boy in the secretary's office in Louisville. Thirty-one years later he was elected president of the road. The most important positions held in that time were the posts of chief clerk in the executive department, assistant to president, first vice-president, and during the federal control period that of federal manager.

CLARK R. FICKES, South Jacksonville, Florida, resident engineer for the Florida East Coast Ry., supervising the erection of the recently completed St. Johns River bridge, died Feb. 8 in a hospital in South Jacksonville, after having been in ill health for some time; his age was 53 years. Major Fickes was well known in railroad bridge construction; among other things the Illinois Central bridge over the Ohio River at Metropolis, Ill., was his work as resident engineer. During the War he served as a major in the engineering corps of the A. E. F.; part of his war time service was as a member of the government equalization board during federal operation of the railroads. Previously he had been connected for several years with the Burlington railroad.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Developments During 1925 in Electrical Equipment

General Electric Company's Efforts Extend the Use of Electricity in Civil Engineering Field

By John Liston
General Electric Co.

THE volume of production of all classes of electrical apparatus was maintained at its early uniform rate throughout the year. The total value of sales slightly exceeded that for 1924.

As in previous articles on this subject, the electrical apparatus, turbines, etc., referred to are all products of the General Electric Co., but references to their development will serve as an indication of the tendencies in design and construction as well as the general trend of progress in the electrical manufacturing industry as a whole.

Turbines—Among the large units started in operation during the year was a 60,000-kw. cross compound machine in the Crawford Ave. station of the Commonwealth Edison Co., Chicago. Among the large units under construction were two 60,000-kw. single-cylinder turbines for the East River station of the New York Edison Co. and a 77,000-kw. cross-compound machine for the Crawford Ave. station of the Commonwealth Edison Co.

Mine and Industrial Haulage—While a number of large storage-battery locomotives were built, the previous maximum rating was not exceeded. Among the larger units were two rated 60 tons and used for coal-stripping operations in Montana, and the method used for charging the batteries while in service indicates the flexibility in operation which can be secured with the storage-battery locomotive. The operation of this equipment was described in *Engineering News-Record*, Nov. 26, 1925, p. 867.

Waterwheel Generators—The unit capacity of horizontal-shaft waterwheel generators was carried to a new maximum by the construction of two 33,000-kva., 11,000-volt, 60-cycle, 360-r.p.m. machines for the Sao Paulo Light & Power Co. of Brazil and of a unit of similar size but rated at 13,200 volts for the San Joaquin Light & Power Co. of Fresno, Calif. Shipment was completed on the four 32,500-kva. machines for the hydro-electric station at Muscle Shoals. The 65,000-kva. generators at Niagara Falls still represent the maximum capacity for hydro-electric units.

Industrial Motors—There were two new complete lines of general purpose motors developed. The new d.c. motors range from ½ to 200 hp. in capacity. The new line of induction motors include sizes from 15 to 200 hp.; these motors have larger shafts and bearing linings than formerly. A new line of high-speed synchronous motors was developed for the operation of centrifugal pumps.

In the field of industrial motor control, the opinion has generally been held that some form of current-limit acceleration was the ideal method for bringing motors up to speed. Time-element acceleration was not seriously considered because of the lack of dependable timing devices. A time-element magnetic control was brought out for use with d.c. motors in which definite time between the closure of successive accelerating contactors is secured.

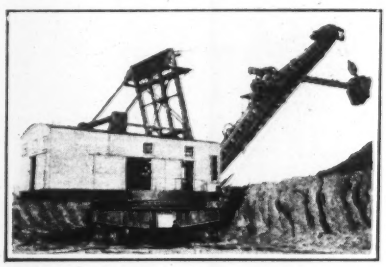
The Ward-Leonard system of control was applied for the first time to the operation of a lift and turnover dumper for railroad coal cars. This dumper is capable of handling a 120-ton car and the cradle hoist requires two 450-hp. d.c. motors which are supplied with power by two synchronous motor-generator sets. At a point on the Pennsylvania R.R. where electric power was not available, the necessary current for operating a vertical lift bridge was secured by means of a gasoline-electric generating set supplying current for the bridge motors; the Ward-Leonard system of control was adopted.

An improved type of mooring tower was erected at the Ford Airport, Dearborn, Mich. (*Engineering News-Record*, Feb. 4, 1926, p. 202.) With this tower an airship can be brought to the ground after mooring at the top, thus greatly expediting the transfer of passengers and cargo. The airship can swing freely around the tower when moored at the top. All of the tower mechanism is controlled electrically by an operator stationed at the top.

7½-Million Candlepower Aviation Beacon Placed at 12½-Mile Intervals Between New York and Chicago

Electric Shovels—Six years ago only about 5 per cent of all shovels built were electrified, whereas in 1925 the proportion had risen to about 40 per cent of the total. Practically all sizes of shovels have been successfully electrified, from the ¾-cu.yd. size to the large outfits used in surface mining which carry booms up to 90 ft. in length with dippers up to 10 cu.yd. in capacity.

A shunt-wound motor was adopted which made the operation of the shovel simpler and permitted the operator to use the motors as brakes. The generators can be directly connected with the motors and the speed and direction of rotation controlled by the field of the generator. In a number of cases where electric current was not available, gasoline-electric shovels have been used.



Electric Shovel Using D.C. Motors and Ward-Leonard Voltage Control

Illumination—The biggest advancement during the year in incandescent lamp design was the development of a practical method of frosting the inside surface of the bulbs by a chemical treatment. The outside of the new bulb does not collect dust, is more easily cleaned and absorbs less light than the outside frost. The new line will include lamps of 15, 25, 40, 60, and 100-watt sizes.

Along the airway between Chicago and New York, 24-in. aviation beacons are installed every 12½ miles. These use a 900-watt, 30-volt lamp, and a parabolic glass reflector, projecting a beam of 7½ million candlepower. They are mounted on 50-ft. steel towers and revolve at 6 r.p.m. Other large lights have been developed for lighting the landing fields.

The sale of equipment for street lighting increased approximately 40 per cent over the figures for 1924, which, in turn, was a record year. As an indication of the high illuminating intensities which are now considered as desirable for street lighting, the city of Cleveland, Ohio, provided Superior Ave. with 25,000 lumen lamps, this being the highest intensity street lighting installation. The previous maximum was 15,000 lumens.

An installation in Lynn, Mass., when completed will be in reality a street lighting exhibit on a large scale. There will be about 2 miles each of 15 different kinds of street lighting equipment.

Barrel Type Concrete Mixers

In *Engineering News-Record*, Dec. 17, 1925, p. 1012, there was published an account of the British Road Show, together with an illustration of one of the exhibits—a barrel type concrete mixer. A letter received from the Sheldon Manufacturing Co., Nehawka, Neb., relative to this, states in part: "This illustration is indeed very interesting to us because this machine was developed at Nehawka, Neb., in 1920 or 1921. We have never exported any of this particular type of machine to England. We sweat blood trying to put this machine over and on the market in America only to meet with almost utter rejection by contractors. However, in the city of Lincoln, Neb., we have placed practically a carload of this type among contractors in that city. We are indeed glad to see this type of mixer getting the publicity it deserves, even though the praise has to be given to the British instead of to the American inventors who first originated and put this type on the market."

Production of International Cement Corp.

The annual combined capacities of the ten allied companies forming the International Cement Corporation is 12,000,000 bbl. This was erroneously reported last week in these columns as 12,000 bbl.

Business Notes

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, on January 2 called for retirement of the remaining $209,000 of the original $400,000 7-per cent gold bond issue. The balance sheet of the company now shows a surplus of approximately $1,000,000.

WESTINGHOUSE ELECTRIC & MFG. CO. has purchased property in Detroit for the erection of a new building to house its district office, warehouses and service stations. This is a further extension of the policy of the Westinghouse Co. to bring these units together in each district. Although plans for the new building are not definite, it is expected it will get under construction during the first half of 1926. A floor space of 100,000 square feet will be necessary to take care of present requirements of the Detroit branch.

EARLE GEAR & MACHINE CO., Philadelphia, Pa., announces that it has sold its centrifugal pump department to the Aldrich Pump Co., Allentown, Pa.

OHIO LOCOMOTIVE CRANE CO., Bucyrus, Ohio, has appointed Harry Kleinhans, Union Trust Bldg., Pittsburgh, Pa., as its representative in the Pittsburgh territory.

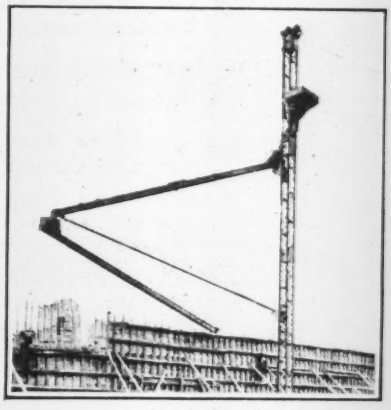
ARTHUR R. BUSH, manager, industrial department, General Electric Co., died at his home in Schenectady, January 24. Mr. Bush was born in Fall River, Mass., in 1861. In 1892 he was made district manager of the Edison General Electric Co. in the New England district. In 1906 he became manager of the power and mining department of the General Electric Co., and later manager of the industrial department.

WILLIAM DICKINSON, first vice-president of Marquette Cement Manufacturing Co., Chicago, died Jan. 27. He was 77 years old.

Equipment and Materials

Improved Tower Concreting Plant Permits Use of Shorter Mast

An improvement in the Monkey-on-a-Stick boom-chute plant manufactured by the Ransome Concrete Machinery Co., Dunellen, N. J., permits the use of a mast 15 feet shorter than heretofore, but giving the same effective horizontal reach. Thus the new design permits the bucket to dump 7½ ft. from the top of the mast whereas in the former construction it dumped 22½ ft. from the top. This is made possible by the use of the trussed strut which



supports the outer end of the 32 foot boom-chute in place of the usual wire rope running from the top of the mast. The strut is carried by the lower bracket and the upper end of the boom-chute is now carried by the upper bracket. The slope of the boom-chute is controlled by means of ropes and blocks connecting the two sliding brackets. This type of plant can be used only with a steel mast and the maximum length of the boom-chute is 32 ft. Where more than two lengths of chutes are required, the additional sections must be supported by a tripod or gin pole.

The new type of plant is claimed to permit also more easy erection. By using the same sliding frame brackets that carry the boom-chute plant to carry the gin pole, the mast is rapidly erected. After erecting the first section of the mast, the two sliding brackets are placed on the front of this section and the gin pole set in holes in the brackets. The brackets are then slid up the mast until the higher one is nearly level with the top of the first mast section. With blocks and falls the next section of the mast is then raised and bolted in place. The sliding brackets are again raised onto this new section, the third section is similarly placed and so on until the mast is completely up. A 26 ft. 8 in. gin pole is part of the complete equipment furnished with the steel mast outfit.

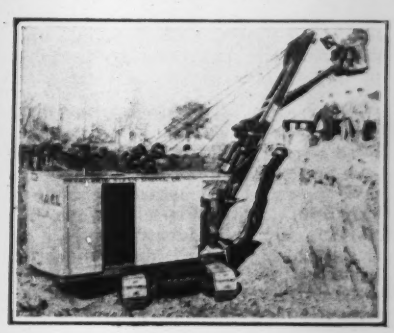
Both Gasoline and Air Engines on New Power Shovel

Instead of taking off the power for crowding and swinging from a single gasoline engine through reversing friction clutches, the new gas and air power shovel manufactured by the Erie Steam Shovel Co., Erie, Pa., uses the gasoline engine for hoisting while direct-connected engines running on heated compressed air provide the power for crowding and swinging.

The gasoline engine is a four-cylinder Waukesha power plant. It is at all times ready to exert its full power for hoisting. However, when the full power of the gas engine is not being used for hoisting or traveling, its surplus power is stored as compressed air until the storage tanks are up to maximum pressure. The air compressor is connected direct to the gasoline engine. Air is piped direct from the compressor to the crowding and swinging engines, and the pressure in the air lines is maintained in the two large storage tanks. These are drawn upon to drive the crowding and swinging engines when the full power of the gas engine is being taken by the hoist. The compressor is equipped with an automatic unloader.

On its way to the crowding and swinging engines, the air is heated to above 400 deg. F., in a heater utilizing the exhaust heat of the gas engine. Preheating the air is claimed to require a smaller part of the gas engine's power and the compressor runs more easily.

It is claimed that these gas-air shovels are averaging only about 5 to 6 gal. of gasoline per 100 cu.yd. The engine runs at normal load and speed all the time, which is the ideal condition for highest fuel efficiency. This gasoline shovel swings and crowds just as fast as a steam shovel, having the same type of direct-connected engines. These engines are always in gear, so that no time is lost waiting for crowding or swinging clutches to take hold. By placing the full power of the air engine on the crowding movement of the shovel, it is claimed that it can

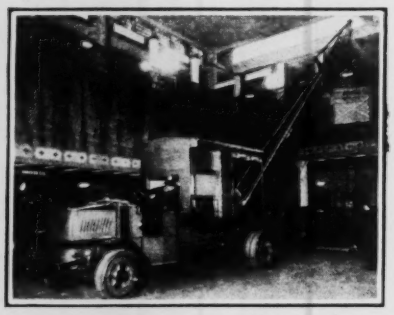


dig harder material than where the crowd is operated from clutches. Another advantage that is claimed is that of more accurate cutting, since the direct-connected air engines give a delicacy of touch that permits accurate placing of the dipper. Finally, it is said that any steam shovel operator finds no difficulty in understanding the machine. It is controlled by three throttle levers—the hoisting clutch being set by an air ram, like the steam ram on some steam shovels.

As a final convenient feature, there is an air starter for the gasoline engine and compressed air is available for rock drilling, pumping, riveting, or other kinds of air-tool work.

A "Working" Exhibit at the Road Show

The accompanying illustration shows the use to which the exhibit of the Universal Crane Co., Cleveland, Ohio, was put at the recent Road Show in Chicago. The 5-ton crane mounted on a 5½-ton Mack motor truck and equipped with a 24-ft. boom plus a 16-ft. extension was used in placing many of the smaller exhibits on the balcony.



The work consisted of lifting a load to the boom head and then backing the crane with the load suspended until the load was over the balcony floor where it was lowered. A patented device, consisting of stabilizing jacks and stirrups, makes possible the moving of the unit with the load suspended.

Publications from the Construction Industry

Wall Tile—INTERLOCKING TILE CORP. has issued a booklet called "The Wall of Protection," which features its especially shaped tile as it is used in many well known buildings throughout the United States. The principle upon which the tile functions is described, and illustrated.

Compressors.—PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., has issued a new bulletin on duplex single stage and two stage cross compound air compressors. The booklet is known as Form 126. It gives specifications, descriptions and photographs of all the mechanical details of these machines, describing their method of operation and regulation. Capacity tables are given for both types of machines.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
February 18, 1926	$17,926,000	$38,562,000	$56,488,000
February 11, 1926	13,382,000	19,342,000	32,724,000
February 19, 1925	20,883,000	27,401,000	48,284,000
Heaviest Week			
1926, Jan. 21	22,012,000	39,472,000	61,484,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	111,566,000	221,719,000	333,285,000
1925	105,422,000	185,466,000	290,888,000

Present Trend of Materials Demand Portends Heavy Spring Construction Volume

Drop in Unfilled Steel Tonnage Offset by Gain in January Shipments On Orders Previously Placed

A GAIN of 15 per cent in steel shipments during January was probably responsible for the 4 per cent drop in unfilled tonnage on books of the U. S. Steel Corporation, Jan. 31, 1926.

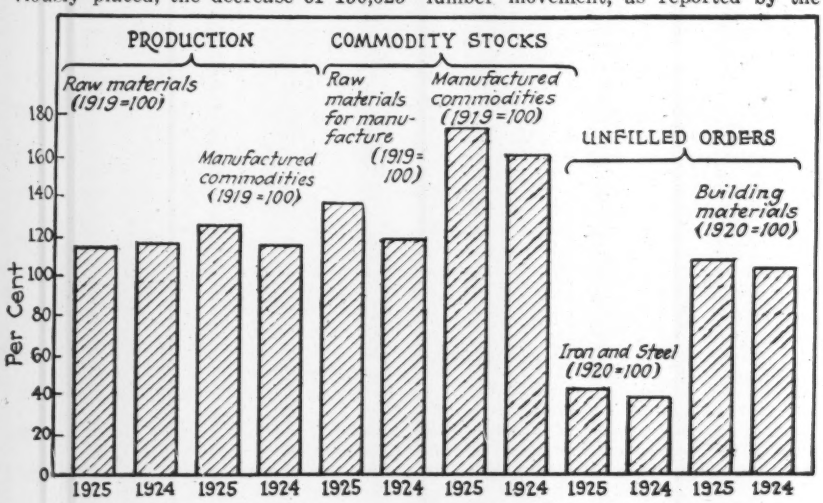
Production of steel ingots, all companies, as calculated by the American Iron and Steel Institute, was 4,153,545 tons for January, 1926, against 3,975,824 for the month preceding and 4,198,564 tons during January, 1925.

If it were not for the known increase in deliveries, on orders previously placed, the decrease of 150,625 tons in the unfilled would suggest a notable slump in steel demand according to the following figures:

Last Day of Month	Tonnage Booked
January, 1926	4,882,739
December, 1925	5,033,364
January, 1925	5,037,323
December, 1924	4,816,676
January, 1924	4,798,429
December, 1923	4,445,330

Lumber follows steel in that there is a declining tendency in new orders and an increase in output.

The following table compares the lumber movement, as reported by the



U. S. DEPARTMENT OF COMMERCE FIGURES—E. N.-R. CHART

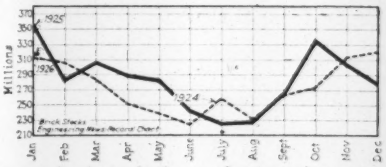
National Lumber Manufacturers Association, for the three weeks indicated:

	Week of Feb. 6, 1926 Ft. b.m.	Corresponding Week In 1925 Ft. b.m.	Preceding Week in 1926 Ft. b.m.
Production	226,196,505	218,412,411	214,774,455
Shipments	228,424,120	230,864,626	253,052,108
Orders	233,528,850	216,555,279	242,346,108

The lumber movement for the first five weeks of 1926 and that for the same period in 1925 follow:

	Production Ft. b.m.	Shipments Ft. b.m.	Orders Ft. b.m.
1926	1,036,553,671	1,142,174,764	1,202,689,035
1925	1,017,858,335	1,099,116,886	1,047,028,267

The brick industry, however, shows an accumulation of orders on books and burned brick at yards throughout the country. Water shipments from yards are being seriously retarded by ice at the present time. The latest report of the Common Brick Manufacturers' Association of America contains the following:



	Burned Brick on Hand M.	Brick Moved From Yards During Month M.	Orders on Books M.
Jan. 1, 1926	316,023	137,788	253,490
Dec. 1, 1925	279,188	144,127	239,636
Jan. 1, 1925	354,477	118,759	202,906

Unprecedented January cement shipments and reserve mill stocks are reported by the Bureau of Mines. Compared with the corresponding period last year, shipments are 11 per cent and stocks 17 per cent greater.

That cement manufacturers do not anticipate an early spring demand greater than that of last year, is shown by the drop of 9 per cent in January production, compared with the same month in 1925.

Florida used 439,786 bbl. of domestic cement during December, 1925 as against 187,616 bbl. from foreign countries.

Of the total December imports, Belgium shipped 100,520 bbl. into Florida; Denmark, 31,574 bbl.; and Norway, 55,522 bbl.

Unit-Bid Prices on Federal Aid Road Projects In Nine States Compared

IN the accompanying tabulation, unit prices bid on various operations and materials in place, on Federal Aid road projects, are shown in nine states.

The work includes grading, earth and gravel surfacing, bituminous macadam, and reinforced concrete paving. One of the projects is a reinforced concrete bridge, involving 172,429 lb. of reinforcing steel. Average costs are: surfacing, $2.14 per sq.yd.; earth excavation, 47c. per cu.yd.; rock excavation, $1.44 per cu.yd.; structural concrete, 1-2-4, in place, $21.18 per cu.yd.; reinforcing steel, 5.8c. per lb.; structural steel, 8c. per lb.; common laborers' wage rate per hr., 39c.

In parts of Ohio and Tennessee the minimum rate for the nine states (30c. per hr.) is paid common laborers, while in Montana this grade of labor receives 50c. and in Maine, 55c. per hr.

Materials were hauled an average distance of 3.4-mi. to the job.

Bid Prices, Bureau of Public Roads, U. S. Department of Agriculture

County	Contract Let to	Type	Thickness of Surfacing, In.	Unit Prices Bid—Materials in Place: Surfacing Sq.Yds.	Surfacing Unit Price	Excavation Cu.Yds.	Excavation Unit Price	Structural Concrete 1-2-4 Cu.Yds.	Structural Concrete 1-2-4 Unit Price	Steel Reinforcing Lbs.	Steel Reinforcing Unit Price	Average Haul, Mi.	Average Hourly Wage, Common Labor
MONTANA													
Park	Standard Cons. Co., Bozeman, Mont.	Gravel	..	.....	.....	50,367	$0.24	211	$20.40	6,314	$0.08	..	$0.50
Roosevelt	LaBlonde, Peck & Powers, Bainsville, Mont.	Cr. gravel	7½	.....	.....	2,016	.75*	46	26.00	2,517	.07	..	.50
Missoula	Pioneer Cons. Co., Bozeman, Mont.	Cr. gravel	7½	.....	.....	40,145	.20	...	.....	.....	.....	..	.50
Yellowstone	J. W. Herschberger Hardin, Mont.	Gravel	..	.....	.....	16,951	.32	...	.....	.....	.....	..	.50
		Gravel	..	.....	.....	3,065	1.15	...	.....	.....	.....	..	...
OHIO													
Washington	B. F. Stanbaugh Ada, Ohio	Cr. Gravel	..	.....	.....	.....	.....	68	26.00	4,471	.07	..	.50
		Reinf. Concrete	..	.....	.....	.....	.....	...	.....	.....	.....	4.5	.30
		Reinf. Concrete	..	.....	.....	.....	.....	...	.....	.....	.....	10.5	...
Clark	W. H. Ringwald & Sons Co. Chillicothe	Bit. Mac	11	.....	.....	13,653	.60	...	.....	29,599	.06	3	.40
		Reinf. Concrete and brick	..	8,356	2.10	2,343	.60	...	.....	170	.06	½	.40
			..	622	3.07								
Athens	R. S. Wright, Newark, Ohio	.....	..	.....	.....	24,681	.48	...	.....	21,839	.06	2	
Defiance	W. L. Johnson Const. Co. Hicksville, Ohio	Reinf. concrete	9	57,864	2.03	.....	.....	...	.....	39,296	.06	7	.35
		.....	..	.....	.....	.....	.....	...	.....	880	.10†	..	...
Trumbull	McDermott Const. Co. Niles, Ohio	Bit. mac	..	29,190	1.82	13,470	.75	...	.....	18,480	.05	1½	.35
Belmont	Wilson-Miller Co Barnesville, Ohio	Grading and Struc.	..	.....	.....	95,358	.48½	...	.....	6,849	.05	9	.30–.35
Coshocton	Lewis & Copeland Lima, Ohio	Reinf. concrete	9	36,838	1.98	.....	.....	...	.....	14,230	.05	3½	.30–.35
Ross	W. C. Brown, Chillicothe	Reinf. concrete	9	11,139	2.25	.....	.....	...	.....	167	.06	2	.30
Athens	F. H. Beckler, Athens, Ohio	Concrete and brick	..	8,164	1.35	.....	.....	...	.....	3,016	.06	2½	.30
			..	5,326	3.75								
TENNESSEE													
Davidson	Grabison Const. Co., Mt. Sterling, Ky.	Concrete	..	78,427	2.30	57,510	.50	230	20.00	24,027	.06	3	.30
		Concrete				780	1.00*						
IOWA													
Adams	Geo. W. Condon, Omaha, Nebraska	Earth	..	.....	.....	158,316	.22	...	.....	.....	.....	3	.35
Crawford		Earth	..	.....	.....	250,375	.11¾	...	.....	.....	.....	..	.35
Crawford	Thomas & Humphrey, Omaha, Nebraska	Earth	..	.....	.....	61,875	.18	...	.....	.....	.....	..	.35
KANSAS													
Reno	Tomlinson Bridge Co. Garfield, Kansas	Bridge, R. C.	..	.....	.....	.....	.....	...	.....	172,429	.044	3	.35–.40
		.....	..	.....	.....	.....	.....	...	.....	1,602	.06†	..	...
Dickinson	L. W. Rexroad Salina, Kansas	Earth	...	.....	.....	35,465	.24	668	18.00	57,557	.06	2	.35
		.....	...	.....	.....	10	2.50*	...	.....	.....	.....	..	.....
Dickinson	The Somers Const. Co. Newton, Kansas	Earth	...	.....	.....	17,891	.35	...	.....	24,305	.055	½	.35
		.....	...	.....	.....	1,931	1.50*	...	.....	.....	.....	..	.....
MAINE													
York	Angelo Sousi Co., Dorchester, Mass.	Concrete	9	17,900	1.65	11,500	1.00	25	25.00	118,400	.04	1	.55
WASHINGTON													
King	John Ottesen Co., Inc., Seattle, Wash.	Grading	..	.....	...	31,330	.48	...	.....	.....	.....	1	.50
WEST VIRGINIA													
Kanawha	Hatfield Const. Co., Huntington, W. Va.	Concrete	..	166,901	2.33	.....	.....	37	20.00	.....	.....	5	.35
MICHIGAN													
Calhoun	Hillding Const. Co. Kendallville, Ind.	Concrete	...	64,941	1.08	31,016	.48	199	14.00	8,636	.06	3½	.40

*Rock excavation. †Structural steel.

Weekly Construction Market

PROPOSED construction projects, contracts already awarded, freight loadings, bank debits and several other vital factors in the present business situation, show gains compared with a year ago.

Private and public work are both substantially ahead of this time last year but more especially the former.

Shipments of building materials and automotive products still form a large part of the total car loadings. Less-car-lot merchandise shipments continue to gain and are at present heavier than at this time in any preceding year; this is an index of the volume of business among small shippers.

The general price trend is downward but not with the same degree of abruptness that characterized the market at this time last year.

Reports received this week from six great industrial centers, covering the principal construction materials, show the following: Decreases ranging from 10c. to 35c. per cu.yd. in aggregates at San Francisco yards; a rise of $5 per M ft. in pine timbers and a drop of 2c. per gal. in linseed oil at Montreal; a decline of ¾c. per gal. in linseed oil f.o.b. New York, during the week.

The gains in proposed construction, specifically stated, were as follows: *Water-works*, Oklahoma, Canada; *sewers*, Missouri; *bridges*, public—Tennessee, Oklahoma, private—Minnesota; *streets and roads*, New Jersey, North Carolina, Georgia, Mississippi, Michigan, Iowa, Missouri, Arkansas, Texas; *industrial buildings*, Pennsylvania, California; *commercial buildings*, public—Missouri, Texas, Oklahoma, private—Ohio, Wisconsin, Minnesota, Nebraska, Colorado; *Federal Government work*, Maryland.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	3.10	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	53%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	45.30	54.00	50.20@51.20	53.00	64.00	51.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.70	2.30	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	2.00@2.20	1.65	1.90	—1.80	1.50	1.25
Sand, cu.yd	1.00	1.50	2.00	2.25	1.25	1.00	—1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	2.00@2.20	1.75	2.50	—1.80	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	57.50	37.75	49.50	27.00	25.00	+65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	.10	.075	.....	075	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1112	.0977	.10	.075	.07	075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	— .87¼	.96	1.13	.88	.99¾	1.14	1.02	1.12	—1.12
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 4, the next on March 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.62). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4½@4¾ per cent, Feb. 15; year ago, 4 per cent.

Time loans: sixty-ninety days, 4⅝@4¾; four-six months, 4⅝@4¾ per cent.

Commercial paper: best names, 4¼ per cent; other names, 4¾ per cent.

On February 1, 1926

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month